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## CIVIL ENGINEERING.

*Extract from the Report of the Board of Trade on Railways, for the year 1851.—Accidents, their Causes and Means of Prevention.**

(Continued from page 222.)

It is to be observed that an improper use of the discretion allowed to the driver not only endangers the safety of the train which he himself is conducting, but in a greater degree that of the trains in front and rear of his own train. It might be impossible to provide a time table for these trains for any length of time before the trains are run, but it is worthy of consideration whether the responsibility as to the hours at which trains are to pass along each railway or part of a railway in either direction should not be placed upon one person, who should be a responsible officer of the Company, without whose permission no engine or train should be allowed to pass along the railway.

The attention of the late Board of Commissioners of Railways, and of your lordships, has been particularly directed to this subject by accidents that occurred during the year 1851.

Upon the occurrence of an accident of a very serious nature upon the Great Western Railway, where it appeared that an excursion train had been along the line of railway, unprovided with a time table, the Commissioners pointed out to the company how desirable it is, not only on account of the comfort and convenience of the passengers, but also with a view to their safety, that these excursion trains, in which the numbers

*From Herapath's Journal, No. 706.

carried are so very great, should be conducted with the utmost regularity; and that arrangements should be made for them along the lines on which they travel, so that their hour of arrival and departure at all stations should be fixed and known beforehand.

In like manner, in communicating to the London and North Western Railway Company, the result of the investigation into a serious accident that occurred at Bicester, the Commissioners urged upon the Directors the great necessity of working their excursion traffic with the utmost regularity. They observed that these excursion trains are generally advertised some days before the public are conveyed by them, and they suggested that there could, consequently, be no difficulty in arranging so that they might be worked throughout their journey to time tables, in the same manner as the ordinary trains, and supplied in every respect with all requisites to secure for them as safe and regular a journey as those trains. In reference to this subject, it is right to observe, that the manager of the London and North Western Railway, whose experience in these matters must give great weight to his opinion, considered that the nature of the traffic during the extraordinary season of 1851 rendered it impossible to fix any specified time for the transit of these trains. The question is one, however, which requires constant and careful consideration, as it cannot be doubted that the taste for this description of amusement having been once acquired in the country, it will continue to a very great extent.

The preceding observations, which are equally applicable to several other cases in which accidents have occurred, have reference particularly to those accidents in which one of the elements concurring to produce them has been the absence of time tables; this is especially to be observed on some railways with reference to goods and mineral trains; but another circumstance which tends alike to produce danger is, that when time tables are provided, the trains are not worked with punctuality to the times denoted in them. This want of punctuality may arise from several causes:

1. From an improper arrangement of the times in the tables, either from not taking sufficiently into account the character of the line itself or the detentions to which particular trains are subject at particular stations. The remedy in this case can always be applied by re-adjusting the time tables experimentally, until they suit the condition of the line and the requirements of the traffic.

2. From the motive power not being sufficient to allow of the appointed times being kept. The deficiency may arise either from the excessive weight of trains or from atmospheric causes, such as damp or frost, by which a bad state of rails is induced and the adhesive power of the engines diminished, or it may arise from very boisterous weather. The remedy in this case is equally evident; no engine should be tasked to do more than it has adequate power to do with certainty at all times and in all ordinary conditions of weather. It being impossible in a long journey to calculate upon the changes and vicissitudes to which a train may be subject from the weather, it would appear but right that the maximum of load to be drawn by any given engine should never exceed the minimum of power to be depended upon under all conditions not of an extraordinary character. On this point, it seems hardly necessary to observe that the locomotive engine is a machine which will permit of very great

accuracy in the performance of its work, and will, if not unfairly tasked, work with as much certainty as a well regulated timepiece.

The simple method for reducing such a rule to practice is, that companies should ascertain, either experimentally or otherwise, this precise load, with reference to the conditions of the particular railway, and the nature and speed of the traffic each engine is intended to convey, which might be registered and known by the driver of the engine, and should on no account be exceeded. Such a provision corresponds with that usually inserted in the bye-laws of railway Companies, by which they book passengers at roadside stations, or stations intermediate between the terminal stations, conditionally upon there being sufficient room for them in the trains.

3. Want of punctuality may arise from purely accidental failures of machinery, such as the fracture of some part of the engine. These causes of delay appear to be comparatively of very rare occurrence.

It only remains to advert to the cases in which inattention to regulations or carelessness of the servants of the Company are involved. It would appear that in 23 out of 41 cases, into the circumstances attending which investigations were made, considerations of this nature were involved.

These may be divided under two distinct denominations:—

1st. Occasional. Those caused by inexperience or carelessness of individuals.

2. Habitual. Those caused by general inattention to regulations on the part of the servants of the Company, exhibiting, as a natural consequence, a laxity of discipline throughout the whole management of the railway.

On this subject, as to which it is very difficult to give any accurate statement, and to separate the two classes, it appears that there is much ground for apprehension that on some railways the disregard of regulations is habitual, and the general discipline lax, from the fact that breaches of the regulations issued by the Directors of Railway Companies for the guidance of their servants are of very frequent occurrence under the immediate supervision of the superior officers of the railways, and in which many of them participate, or of which at any rate they are cognisant. This may be induced by the regulations themselves not being very explicit, as appears to have been the case in some of these accidents, as, for instance, the collision that occurred on the Eastern Counties Railway at Ponder's End, on the 8th January, 1851; or by defective supervision and inspection on the part of the railway Companies over their servants, such as would appear to have been the case upon the Midland Railway, as shown by the accidents, the reports and correspondence relative to which are to be found in Appendices 48 to 53.

Discipline upon railways is of the greatest importance both to the public and to the Companies, who are subject by the occurrence of serious accidents, to great losses, and to the payment of compensation to injured persons; but notwithstanding the direct interest which the Companies thus have in maintaining discipline, and enforcing the regulations which they themselves have considered necessary for the safe conduct of the traffic upon their lines, it has been the duty both of the Commissioners of

of Railways and of the Lords of this Committee to animadvert in some cases in very pointed terms upon the neglect of these regulations.

It is a subject to which it is desirable that the attention of railway Companies should be especially called, both as affecting the safety of the public, and the profits of their undertakings, as the only security the public can have in this respect is in the Companies themselves, who alone have the power, by the adoption of carefully considered regulations and careful supervision, to enforce an efficient state of discipline.

It appears advisable, in considering this question, that some few observations should be made upon a proposition which is considered by many as holding out a prospect of obtaining a greater degree of safety upon railways, viz., to prescribe an interval of time to be observed upon all railways between succeeding trains, and which should at all times be strictly enforced.

This proposition, as has been stated above, has been adopted on some railways, but for the reasons there given does not appear alone to afford a sufficient security for the safe working of a railway. There are other reasons why any rule as to this interval could not be generally applied. The object to be gained in fixing an interval of time between trains following each other upon the same line of rails is, that upon an accident occurring by which the stoppage of a train is occasioned, and the line of railway obstructed, there shall be sufficient time to admit of a signal being sent out to protect the rear of the train that is stopped. This time must depend on the nature of the signal. In fine weather a light or a flag is employed, according as the necessity for its use may arise, by night or by day, which may be seen for a considerable distance, provided the view be unobstructed either by curves or objects in the vicinity of the railway. In foggy or thick weather a detonating signal is attached to the rail, which, upon being exploded by the passage of an engine, gives a loud report, and thus communicates the required signal to the driver.

This latter signal requires that the man, whose duty it is to fix it should actually have arrived at the place where the signal first becomes available, and is, therefore, the most unfavorable condition under which signals can be applied.

Upon the people in charge of a train receiving a signal to stop, it is their duty to apply the means provided upon the train for arresting its progress with the greatest alacrity. The distance to be traversed by the train before it will come to rest will depend, first, upon the alacrity with which the means are applied, and, secondly, upon the extent of these means as compared with the weight and speed of the train, taking also into consideration the inclinations and curves upon the line, and the condition of the weather.

The distance, therefore, from any obstacle at which a signal must be given in order to secure the safety of the traffic, requires to be ascertained with reference to each railway, and the weight of engines and trains in general use upon it, the speeds at which they travel, and the means for arresting their progress provided upon each train.

The interval between succeeding trains should be made up, therefore,

1st. Of the time consumed in stopping the first train;

2d. Of the time consumed by the guard or man who is responsible

for applying the signals, in going out to the required distance with those signals. This time, in a case in which considerations of public safety are involved, should be determined under the most unfavorable conditions in which the signals can require to be applied, such as a dense fog.

A liberal margin should, however, be allowed in each consideration in the interval so calculated, which will seldom be less then ten minutes, and may be more. Upon railways where the means provided for arresting the progress of a train are very powerful, it might be reduced.

Few Companies adopt a less interval than ten minutes; all, however, have rules by which it is imperative upon their servants to exhibit at all signal-stations, the "Danger" or "Stop" signal for a certain interval after the passing of every train, so as to prevent at each of these points, which average a distance of not more than three miles apart on all the railways in the kingdom, a diminution in the interval considered necessary by the managers of the railways to be maintained between the trains.

In any regulations of this nature, as in all others that may be adopted, safety would still depend upon the vigilance of the servants of the Companies, and the efficiency of the machinery.

From these considerations it appears manifest, that to prescribe a certain fixed interval of time applicable alike to all trains, taking the responsibility out of the hands of the Companies, would be improper, as each line, with its gradients and curves, and the train arrangements in force upon it, would require separate consideration. To enforce upon all Companies an uniform regulation in this respect would, moreover, be unjust; for upon a line of light traffic, where trains do not succeed each other with great rapidity, fewer servants may be employed upon the trains, and fewer brakes used for stopping the trains, a longer interval of time being adopted; whereas, upon a line of heavy traffic railway Companies may find it in their interest occasionally to station men within signalling distance along the line of railway, in order to save the time consumed by a guard running out with and placing his signal when his train shall, from any cause, have been obliged to stop.

The prescription of a minimum interval, as deduced from a line of great traffic, would tend to diminish rather than increase safety in traveling, as it might lead those Companies which do not use the precautions employed upon the line of great traffic to adopt the minimum interval without examination of the data and details upon which it was founded, and so relieve them, in a great degree, of that responsibility which should attach to them.

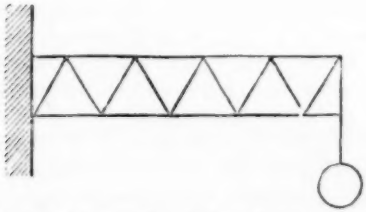
Probably one of the best means that can be recommended for promoting the safety of the public upon railways is an extended use of the electric telegraph, by means of which the traffic upon a railway may be so worked that no two trains shall be upon the same part of the line between neighboring telegraph stations at the same time. All lines do not possess this adjunct to their establishment, which requires a considerable outlay of capital, and a large establishment of clerks. Upon some lines the telegraph stations are not sufficiently near to one another to allow of its being used for this purpose, so that, although the use of the telegraph may, no doubt, be very much extended, its adoption upon all lines, and its employment in the manner here described, cannot be enforced.

*An Investigation of the Strain upon the Diagonals of Lattice Beams, with the resulting Formulæ.* By WILLIAM THOMAS DOYNE, Assoc. Inst. C. E., and WILLIAM BINDON BLOOD, A. B.*

Continued from page 228.

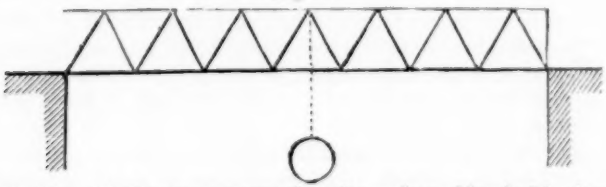
*Appendix.*—Most of the following formulæ, giving the strains upon the diagonal bars of diagonally-framed beams, were arrived at before the construction of the model, which was made for the purpose of practically verifying them. The formulæ are given without any mathematical demonstration, as this is easily supplied by those who desire it.

Fig. 3.



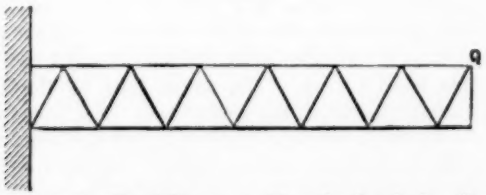
*Case* I. (fig. 3.) Semi-beam loaded at the extremity. Let $w$ = weight, $\pi$ = length of diagonal bar, $d$ = depth of beam, $\Sigma$ = strain of diagonal; then $\Sigma = w\frac{\pi}{d}$, and is uniform throughout the beam.

Fig. 4.



*Case* II. (fig. 4.) Beam supported at the ends and loaded in the middle: then $\Sigma = \frac{1}{2} w\frac{\pi}{d}$, also uniform.

Fig. 5.

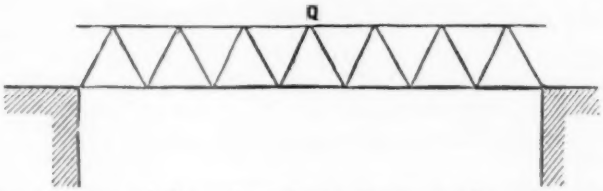



*Case* III. (fig. 5.) Semi-beam uniformly loaded. Let $\mu$ = load on unit of length, $k$ = distance of diagonal from Q; then $\Sigma = \mu k\frac{\pi}{d}$, varies as $k$.

* From the London Civil Engineer and Architect's Journal, January, 1853.

*Case* IV. (fig. 6.) Beam supported at the ends and uniformly loaded. Let $k$ = distance from Q, the centre; then $\Sigma = \mu k \frac{\pi}{d}$.

Fig. 6.

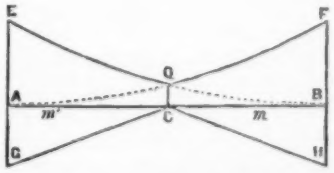



It is easy to extend these formulæ to the cases of continuous beams; thus—

Fig. 7.

*Case* V. (fig. 7.) In a beam AC, supported at the ends and the middle point, and uniformly loaded; let Q be the point of maximum horizontal strain, AQ being $\frac{3}{8}$ of AB; and $k$ = distance from Q; then $\Sigma = \mu k \frac{\pi}{d}$. Thus the strain increases uniformly from Q both ways to A and B, where it is a maximum. This formula applies to all cases of continuous beams, $k$ being always measured from the point of maximum horizontal strain in each span. In all these cases of uniform loading, $k$ is measured to the upper end of the diagonal, if the load be attached to the bottom of the beam; to the lower end of the diagonal, if the load rest on the top of the beam; and to the middle point of the diagonal, if the load be supported equally by top and bottom.

Fig. 8.




*Case* VI. (fig. 8.) Let A B be a beam of diagonal framing supported at A and B. Suppose a train of uniform weight, and whose length is not less than A B, to move from A towards B. The maximum strain on a diagonal, at any point ($m$) in the half C B, is when the front of the train is at ($m$), and the maximum strain at ($m$) is when the tail of the train is at ($m$). The strain on a diagonal at the middle point C is a maximum when an end of the train is at C. These maximum strains are proportional to the ordinates of the parabolas E Q and Q F, whose vertices are at B and A respectively, and in which the ordinates A E and B F represent the strains at the extremities with uniform load. The strain at ($m$) varies as $\overline{Am}^2$; at ($m'$) as $\overline{Bm'}^2$. If, therefore, A E and B F be taken to represent the strains due to a uniform load of greatest density (say engines), and if A G and B H be taken equal to the strains due to the weight of the bridge itself, and the parabolas E Q and Q F and the lines C G and C H be drawn, the ordinates of the figure G E Q F H C will represent the

greatest possible strains upon the several diagonals. From this it appears that the greatest possible strain at the centre is one-fourth of that at the ends, due to the moving load alone.

To express these strains by formulæ, let $k = Cm\ Cm'$, $l = A\,B$, $\pi =$ length of diagonal bar, $d =$ depth of beam, $\mu =$ density of constant load, $\mu' =$ density of moving load, $\Sigma =$ strain on diagonal; then

$$\Sigma = \mu k \frac{\pi}{d} + \mu' \frac{(\frac{1}{2}l + k)^2}{2l} \cdot \frac{\pi}{d}.$$

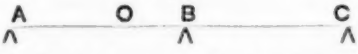
If $k = o$ we have at the middle point $\Sigma = \frac{1}{8}\mu' l \frac{\pi}{d}$.

If $k = \frac{1}{2}l$ we have at the ends $\Sigma = \frac{1}{2}(\mu + \mu') l \frac{\pi}{d}$.

If the length of the train be less than A B, the effect will be to diminish some of the strains towards the ends, so that the foregoing diagram and formulæ cover every case.

With respect to continuous beams there is one point deserving of notice, viz: the case of unequal loading of the different spans. This is important, because it diminishes the advantage derived from continuity in all cases of moving loads. For instance—

Fig. 9.




*Case* VII. (fig. 9.) In the case of a beam supported at the ends and middle point, if $\mu =$ unit of load on A B, $\mu' =$ unit of load on B C, O the point of contrary flexure; then,

$$A\,O = \frac{7\mu - \mu'}{8\mu} \cdot l;$$

$$\text{The pressure on A} = \frac{7\mu - \mu'}{16} \cdot l;$$

$$\text{“ “ B} = \tfrac{5}{8}(\mu + \mu') \cdot l;$$

$$\text{“ “ C} = \frac{7\mu' - \mu}{16} \cdot l.$$

The horizontal strain in A O is greater (if $\mu$ be greater than $\mu'$) than when the spans are equally loaded, and the diagonals towards A are more strained, and those towards B less so.

Analogous formulæ may be derived for the other cases of continuous beams. As an example, suppose a beam over two spans of 120 feet each. With an uniform load, the point of contrary flexure is 90 feet from the extremity. But if the load on one span is double that on the other, this point is 97·5 feet from the extremity of the beam. Several very careful experiments have been made upon the deflexion of steel bars, to test the accuracy of these formulæ, and of those for the case of a beam on four supports. The results of these were very satisfactory, the measured deflexions agreeing very closely with those calculated from the formulæ.

*Discussion.*—Mr. Doyne said his advocacy of the system of lattice construction was based upon careful theoretical investigation and practical experience, both by experiments on a sufficiently large scale and by the construction of bridges of a considerable span. He had determined to enter thoroughly into the investigation of the subject, and therefore had, in conjunction with Mr. Blood, so constructed the large model as that each strut and tie could be removed, and, by the substitution of a dynamometer, the strain in any part could be measured. The experiments were in all cases made before the calculations, and the coincidence between the results was remarkable. It would be observed that the model exhibited equally well the effects of an uniform or of a partial load, and as from the construction the action of the struts and ties could not be reversed, all the variation of the strains consequent on the varying load must be rendered palpable. Since this investigation had been made, Mr. Doyne had constructed for the Aberdare Iron Company a bridge on this principle, of 140 feet span, for carrying a railway over the river Taff. It was originally intended only to bear one line of rails; but two lines had been laid down; the depth of the girders was 12 ft. 6 in.; the lattice-bars were made of plain flat rolled iron 3 inches by $\frac{1}{2}$-inch for 14 feet in the centre, and 4 inches by $\frac{1}{2}$-inch for 14 feet at each end, put together with rivets 1 inch in diameter. The bridge had frequently been loaded with 75 tons, which would give a strain of $6\frac{1}{4}$ tons per square inch of section on the bars. There was a regular traffic of about 100,000 tons per annum over it. As to the cost of construction, the Aberdare Company supplied the iron to Messrs. Brown, Lennox, and Co., who put the girders together on the spot, and raised them up to their positions by hydraulic press power. The total weight of iron employed was 53 tons, and the cost of the bridge was 11*l.* 10*s.* per ton nett, which was 4*l.* 7*s.* per foot run of the span, exclusive of the cost of erection and carriage. Now, comparing this with the box-beam girder—the sectional area of the top and bottom must be identical in either case, and Mr. Doyne must contend that the method of uniting them by the diagonal struts and ties, which were comparatively small pieces of cheap and easily-handled rolled merchant bar-iron, simply punched at the ends and at the intersections for the rivets, was a simpler and easier system than riveting together a number of sheets of iron, which, taking weight for weight to cover that area, would be barely $\frac{3}{8}$-inch in thickness, and would therefore require nearly as much more metal for the angle-irons, the overlap of the plates, and the stays, to give the connecting web stiffness and to prevent from buckling. Besides, there would be a considerable saving in the first cost of common bars as compared with boiler-plates, and the cost of labor must certainly be less in the diagonal construction than in the plate-iron riveted web; thus he contended that theoretically and practically, for girders of all dimensions, the system he had advocated did possess important advantages.

Mr. P. W. Barlow said he had used girders of the triangular construction, and was well satisfied with them, both as to cost and strength: for spans of moderate dimensions, he preferred the simple equilateral triangulation to the more complicated system of lattice-work; the calculation of

the strength was easy, and that form offered great facility for construction.

Mr. Doyne explained that his reason for adopting the lattice form instead of the simple triangulation was, that with deep girders smaller sized bars and rivets were required, inasmuch as the points of suspension and attachment were closer together with the lattice system than with the simple triangulation, for which latter construction, in the case of wide spans, large dimensions of iron must be adopted, the pins would require to be very strong, and the holes must be cut out by expensive machines, instead of by a simple punching-press. In deep girders it was convenient to place the platform or roadway midway of the depth, which just suited the lattice form, but was not so convenient with the simple triangulation. He had only used the simple triangulation for spans not exceeding 60 feet, and generally for shallow girders, but he believed that some girders had been made on Captain Warren's plan for much greater spans. The question between the simple and the close triangulation was, in a great measure, one of comparative cost of construction, and he was inclined in favor of the lattice form, chiefly because of its facility and economy.

Captain O'Brien directed attention to a bridge erected by Mr. Osborne at Ballysimon, on the Waterford and Limerick Railway. The principle of construction was stated to be simple, each girder consisting of a top and bottom sill, kept apart by cast or wrought iron diagonal struts, intersecting each other and forming a double triangulation, with wrought-iron ties through the abutting pieces of each pair of struts. The platform was carried by transverse timber beams laid on the bottom sill; the clear span was 86 feet, and the cost, exclusive of the cross beams and platform, was 1289*l*. Bridges on this principle of 50 feet span had been erected complete for 625*l*. It was stated that there was not any dead weight or useless material, that the pieces composing the girders were mere duplicates of each other, were easy to be handled, and required no skill in adjusting; the beams might be dead level or be slightly cambered; they occasioned no thrust on the abutments, as they rested on rollers, to allow for contraction and expansion; the deflection of the bridge of 86 feet span was only $\frac{5}{16}$ inch, when tested by a weight of 80 tons.

Mr. Doyne objected to the system of construction of the bridge just referred to, as under a varying load some parts were completely relieved from pressure, whilst the others had an undue proportion thrown on them. Under all circumstances some of the struts were relieved from strain, which was borne by the ties; therefore the material employed in those struts was not only unserviceable, but it added to the load on the bridge.

Mr. C. May directed attention to a bridge designed by Mr. J. Cubitt, on the single triangulation principle, constructed by Messrs. Fox, Henderson, and Co., for carrying the Great Northern Railway across Newark Dyke: the span 250 feet, and the diagonal ties nearly 17 feet long.

Mr. Hawkshaw said he had constructed many lattice bridges of various spans; an enumeration of a few of them, with some of their leading particulars, would suffice to give an idea of them:—The Paddock viaduct near Huddersfield, which was 80 feet high, was constructed in its centre

part of continuous beams of malleable iron lattice work 345 feet in length, 7 feet deep, and spanning four openings, each of 80 feet clear width. The viaduct was built for two lines of rail; there was one girder under each rail and one on each side, forming the fence, making six girders altogether; they were braced transversely with lattice bracing, and the girders were covered with a planking 6 inches thick, laid transversely. The breaking weight of the girders, treating them as separate girders over each opening, was rather more than three times a load of $1\frac{1}{2}$ ton per lineal foot on each line of way, and the cost of the iron work complete at 20*l.* per ton was 15*l.* per lineal foot. The bridge over the Leeds and Liverpool canal and the canal wharf at Liverpool were also constructed of malleable iron lattice-work, differently disposed from that at Paddock. These bridges were in situations where there was only a depth of 2 feet between the level of the rails and the headway required to be left beneath the line of the whole width of the openings. There were four openings, one of 120 feet span, one of 112 feet span, and two of 70 feet span each. Each opening was spanned by two double lattice-girders, one on each side of the lines of way; transverse plate-iron girders 15 inches in depth were bolted to the bottom of these, and on them the two lines of railway were laid. The large girders for the span of 120 feet were 12 feet deep in the centre, and diminished to 6 feet in depth at the ends. The other girders were proportionably of less dimensions. In all these segmental lattice-bridges the breaking weight was calculated at fully four times a load of $1\frac{1}{2}$ ton per lineal foot on each line of way. The cost per lineal foot, at 17*l.* per ton, was—in the 120 feet span, 28*l.*; in the 112 feet span, 25*l.*; in the 70 feet span, 17*l.* The lattice was in many cases a convenient and economical mode of connecting the top and the bottom ribs of a girder; the simplest and cheapest application of the principle was when the platform could be placed on the girder; it was also less subject to casualty than when the platform was placed at some distance up the sides.

Mr. Brunel said that in considering this question it was necessary to draw a distinct line of demarcation between the lattice-bridge and that kind of construction called Warren's girder; in the former much of the material employed was useless, whilst in the latter, if properly proportioned, every part was made to perform its duty, either bearing pressure or intension; he was inclined to think it might be rendered nearly the most economical as well as the most efficient kind of girder for spans of a certain extent.

Mr. Rendel said, that Mr. C. H. Wild had recently investigated carefully for him the proportions and scantlings of some bridges on Warren's principle, intended to carry the lines of railway in India, for which locality their simplicity of construction, being composed of multiples of a few parts, the ease with which they could be transported to their destination, and the facility of putting them together, peculiarly fitted them. They were also cheap: a bridge of a span of 220 feet would cost about 15 per cent. less than a lattice-bridge for the same span. It was necessary not to confound the two principles, as the Warren girder was decidedly superior to the lattice-bridge.

## *On Longitudinal Compression of Materials.*

*Results of Late Experiments upon the Resistance to Compression of various Substances of the Dimensions of one Cubic Inch.*

| Materials. | Weight in lbs. | Materials. | Weight in lbs. | Loss by freezing in 10·000 of an oz. |
|---|---|---|---|---|
| METALS. | | STONES, &c. | | |
| Cast iron, gun metal, | 105·000 | Granite, Patapsco, | 11·200 | |
| Wrought iron, | 116·000 | *Sandstone, Aquia Creek, | 5·340 | |
| " begins to yield, | 40·000 | † " Seneca, | 10·764 | |
| Brass, fine, | 164·800 | " Aquia Creek, strata, laid horizontally, | 8·332 | |
| Copper, cast, | 117·000 | ‡Marble, Stockbridge, | 10·382 | 8·8 |
| Tin, cast, | 15·550 | § " East Chester, | 23·917 | 6·2 |
| Lead, | 7·730 | ‖ " Symington, large crystals, | 11·156 | |
| WOODS. | | " same, strata horizontal, | 10·124 | |
| Oak, | 4·500 | " same, strata vertical, | 9·124 | |
| Pine, | 1·930 | " same, fine crystals, | 18·248 | |
| Elm, | 1·290 | " Italian, | 12·624 | |
| STONES, &c. | | " Lee, Mass., | 22·702 | 9·9 |
| | | " Hastings, N. Y., | 18·941 | 11·8 |
| Gneiss, | 19·680 | " Montgomery co., Penn., | 8·950 | 8·8 |
| Brick, hard, | 4·36· | " Baltimore, large crystal, | 8·057 | 21·9 |
| common, | 4·00( | " " small crystal, | 18·061 | 8·1 |
| fire, | .... | | | |

*Same as that of the Capitol, Treasury Department, and Patent Office, Wash., D. C.
† " " " Smithsonian Institute.
‡ " " " City Hall, New York.
§ " " " General Post Office, Washington, D. C.
‖ " " " National Washington Monument.

*Resistance of Stones, &c., to the Effects of Freezing.*—Various experiperiments show that the power of stones, &c., to resist the effects of freezing, is a fair exponent of that to resist compression.

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For the Journal of the Franklin Institute.

### *Report of Experiments on Gunpowder, made at the Washington Arsenal in* 1843 *and* 1844. By Capt. ALFRED MORDECAI, U. S. Army.

The following selection of results and properties of gunpowder, the loss of force by windage, the effects of wadding, &c., &c., was made by Charles H. Haswell, Marine Engineer, for insertion in a new edition of his Engineers and Mechanics' Pocket-book, and as it was impracticable for him to appropriate any more space for this subject than that required for the essential elements involved in the general varieties of powder, &c., &c., he was constrained to give but a partial selection of the varieties of powder experimented with.

The report of Capt. Mordecai embraces the results of careful systematic observations effected with the aid of a cannon and musket pendulum, and is of a character not only to manifest his suitability for the labor so judiciously confided to him, but to reflect high honors upon the corps of which he is so distinguished a member.

*Table of Results and Properties of Gunpowder, determined by the Experiments and Report of* Capt. A. Mordecai, U. S. Army.

24-Pounder Gun.—Weight of ball and wad, 24·25 lbs.; weight of powder, 6 lbs.; windage of ball, ·135 inch.
Musket Pendulum.—Weight of ball, 397·5 grains; weight of powder, 120 grains; windage of ball, ·05 inch.

| Kind of grain. | Composition. | | | Manufacture. | | Number of grains in ten Troy grains. | Relative quickness of burning. | Water absorbed by exposure to air. | Relative force. Standard = 1000. | | | | Weight of a cubic foot, loose. | Designation of powder in the experiments. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 24-Pounder gun. | | Musket Pendulum. | | | |
| | Saltpetre. | Charcoal. | Sulphur. | Where from. | Glazing. | | | | Initial velocity in feet. | Force. | Initial velocity in feet. | Force. | | |
| | | | | | | | | Per ct. | Per sec. | | Per sec. | | Oz. | |
| Cannon, large, . | | | | | Glazed. | 77 | 275 | 2·27 | 1710 | 964 | .... | 677 | 916 | A 1 |
| small, . | | | | | " | 569 | 314 | 3·35 | 1659 | 935 | .... | 720 | 927 | 3 |
| Musket, . . | | | | | " | 1134 | 214 | .... | .... | .... | 1484 | 808 | 896 | 4 |
| Rifle, . . | 76 | 14 | 10 | Dupont's Mills, Wilmington, Delaware. | " | 6174 | 142 | .... | .... | .... | .... | 907 | ... | 5 |
| Musket, . . | | | | | " | 5344 | 282 | 3·55 | 1668 | 940 | .... | 728 | 1044 | E 5 |
| Rifle, . . | | | | | " | 1642 | ... | .... | .... | .... | .... | 834 | 937 | X p 4 |
| Sporting, . . | | | | | " | 13152 | ... | .... | .... | .... | .... | 943 | 955 | p 5 |
| Cannon, uneven, | | | | Esquerades, French, | " | .... | ... | .... | .... | .... | .... | 935 | ... | French. |
| large, . | | | | | Rough. | 166 | 183 | 2·09 | .... | .... | .... | 788 | 780 | F |
| medium, . | 75 | 12·5 | 12·5 | Dupont's Mills, Delaware, | " | 103 | 182 | 1·91 | 1552 | 8715 | .... | 756 | 775 | 1 |
| very large, even | | | | | " | 163 | 186 | 2·95 | 1527 | 861 | .... | 768 | 751 | 2 |
| Sporting, . . | 77 | 13 | 10 | | " | 211 | 200 | .... | 1504 | 848 | .... | 740 | 762 | 0 |
| Blasting, uneven, | 70 | 15 | 15 | Dupont's Mills, Delaware, | Highly glazed. | 72808 | 100 | 4·42 | 1774 | 1000 | 1888 | 1000 | 1047 | G 6 |
| Cannon, medium, | 76 | 13·7 | 10·3 | Garesché, Delaware, | Glazed. | 295 | 212 | .... | 1660 | 936 | .... | .... | 917 | S |
| Rifle, . . | 76 | 15 | 9 | Loomises, Hazard & Co., | " | 191 | 216 | 2·69 | .... | .... | .... | 754 | 879 | B 2 |
| Sporting, . . | | | | Connecticut, | " | 2378 | 204 | .... | .... | .... | .... | 820 | 934 | C 5 |
| Cannon, uneven, | | | | | " | .... | ... | .... | .... | .... | .... | 888 | ... | 6 |
| Musket, . . | 75 | 15 | 10 | Waltham Abbey, England, | " | 174 | ... | .... | .... | .... | .... | 731 | 872 | English. |
| Rifle, . . | | | | | " | 2832 | ... | .... | .... | .... | .... | 841 | 844 | " |
| Sporting, . . | ... | ... | ... | J. Hall & Sons, Dartford, Eng., | " | 11600 | ... | .... | .... | .... | .... | 865 | 820 | " |
| Cannon, uneven, | 75 | 12·5 | 12·5 | Bouchet, France, | Rough. | .... | ... | .... | .... | .... | .... | 980 | ... | " |
| Musket, . . | | | | | | 316 | ... | .... | .... | .... | .... | 835 | 804 | French. |
| Musket, . . | | | | Stockholm, Sweden. | Glazed. | 2410 | ... | .... | .... | .... | .... | 796 | 830 | " |
| | | | | | | .... | ... | .... | .... | .... | .... | 742 | ... | Swedish. |

Note.—The report of Capt. Mordecai embraced a greater number of specimens, and furnished other elements. A selection only has been made of such qualities of powder, results, &c., as are considered essential for general purposes.

*Table showing the Increase of weight in 1 lb. of various kinds of Gunpowder, exposed to Moisture for a period of 17 days.*

| Kind of powder. | Increase of Weight. | Kind of powder. | Increase of Weight. | Kind of powder. | Increase of Weight. |
|---|---|---|---|---|---|
| | Per cent. | | Per cent. | | Per cent. |
| A 1 | 2·77 | E 5 | 3·55 | F 2 | 2·95 |
| 3 | 3·35 | F | 2·09 | G 6 | 4·42 |
| B 2 | 2·685 | F 1 | 1·91 | | |

The powders A and B were slightly caked by this exposure; E much more so; the F's were not at all caked; and the G became hard caked on the surface after 6 days' exposure.

*Table showing the Relative Force, by the Musket Pendulum, of various kinds of Gunpowder in good order, and of the same Powders dried, after Exposure to Air saturated with Moisture.*

| Kind of powder. | Powder in good order. | Powder dried after exposure to moisture. | | | Loss of force by the exposure. | Gain of force by the exposure. |
|---|---|---|---|---|---|---|
| | Initial velocity of ball. | Moisture absorbed. | Absorb'd moisture retained. | Initial velocity of ball. | | |
| | Feet. | Per cent. | Per cent. | Feet. | Per cent. | Per cent. |
| A 1 | 1256 | 20·88 | ·83 | 891 | 29·06 | .... |
| A 4 | 1499 | 23·25 | ·29 | 1480 | 1·27 | .... |
| A 5 | 1648 | 27·05 | ·31 | 1516 | 9·98 | .... |
| E 5 | 1351 | 23·11 | 0· | 1472 | .... | 8·96 |
| F 1 | 1404 | 20·83 | 0· | 1315 | 6·34 | .... |
| F 0 | 1373 | 22·59 | ·20 | 1143 | 16·75 | .... |
| G 6 | 1856 | 19·53 | 0· | 1472 | 20·69 | .... |

The least dense powders return nearest to their original strength. The gain by the powder E 5 arose from the circumstance that the density of it in its original state was so great as to impede its combustion; hence, the grain becoming swollen by exposure to moisture, and its density correspondingly diminished, its combustibility was increased in a greater degree than its strength was impaired by the moisture.

In a large charge, like to that of a 24-pound gun, Captain Mordecai thinks the result would not be the same.

*Table showing the loss of Force by Windage.*

24-Pounder Gun.

| Powder. | Ball. | Initial velocity of ball in feet per second. | | | |
|---|---|---|---|---|---|
| | | Without windage. | Windage. ·135 inches. | Windage. ·245 inches. | Windage. ·355 inches. |
| Pounds. | Pounds. | Feet. | Feet. | Feet. | Feet. |
| 4 | 24·25 | 1631 | 1450 | 1332 | 1197 |
| 6 | 24·25 | 1963 | 1702 | 1596 | 1465 |

A comparison of these results shows that 4 pounds of powder give to a ball without windage nearly as great a velocity as is given by 6 lbs. to a ball having 0·14 inch windage, which is the true windage of a 24-pound

ball; or, in other words, this windage causes a loss of nearly *one-third* of the force of the charge.

*Table showing the loss of Force by the Vent of a Gun.*

24-Pounder Gun.

| Powder. | Vent. | Veloc. of ball. | Powder. | Vent. | Veloc. of ball. |
|---|---|---|---|---|---|
| Pounds. | Inches. | Feet. | Pounds. | Inches. | Feet. |
| 3 | ·175 | 1251 | 6 | closed. | 1705 |
| 3 | closed. | 1259 | 6 | ·25 | 1625 |
| 6 | ·25 | 1696 | 6 | ·175 | 1627 |
| 6 | ·175 | 1702 | 6 | closed. | 1612 |

These experiments show that the loss of force, by the escape of gas from the vent, is altogether inconsiderable, when compared with the whole force of the charge.

*Table showing the Effect of different Descriptions of Wadding.*

| Powder. | | Kind of wad. | Velocity per second. |
|---|---|---|---|
| Kind. | Weight. | | |
| | Grains. | | Feet. |
| G 2 | 77 | Ball wrapped in the cartridge paper, the whole crumpled into a wad and inserted over the p'dr. | 1308 |
| | | | 1377 |
| " | 77 | 1 felt wad on powder and 1 on ball, . . | 1346 |
| " | 77 | 2 felt wads on powder and 1 on ball, . . | 1482 |
| French sporting, | 77·17 | 1 elastic wad on powder and 1 on ball, . . | 1096 |
| | | | 1169 |
| " | 77·17 | 2 pasteboard wads on powder, . . . | 1200 |
| " | 77·17 | 2 felt wads on powder, . . . . | 1088 |
| G 6 | 77·17 | 2 elastic wads on powder, . . . | 1100 |
| | | | 1079 |
| " | 77·17 | 2 pasteboard wads on powder, . . . | 1193 |
| " | 77·17 | 2 felt wads on powder, . . . . | 1106 |
| " | 77·17 | 2 felt wads on powder and 1 on ball, . . | 1190 |
| " | 77·17 | Ball wrapped in the cartridge paper, as in the first experiment, . . . . . | 1237 |

The *felt wads* were cut from the body of a hat, weight 3 grains.

The *pasteboard wads* were $\frac{1}{10}$-th of an inch thick, weight 8 grains.

The *cartridge paper* was $3 \times 4{\cdot}5$ inches, weight 12·82 grains.

The *elastic wads* were "Baldwin's indented," a little more than $\frac{1}{10}$-th of an inch thick, weight 5·127 grains.

The most advantageous wads are those made of thick pasteboard, or of the ordinary cartridge paper.

*Comparison of the Force of a Charge in various Arms, as determined by Experiments in Small Arms of Rifle Calibre.*

| Kind of Arm. | Lock. | Powder. A 5. | Windage. | Ball's Weight. | Velocity. |
|---|---|---|---|---|---|
| | | Grains. | Inches. | Grains. | Feet. |
| Common rifle, . . . | Percussion. | 100 | ·015 | 219 | 2018 |
| " " . . . | " | 70 | ·015 | 219 | 1755 |
| * Hall's rifle, . . . | Flint. | 70 | ·000 | 219 | 1490 |
| * Hall's carbine, . . . | Percussion. | 70 | ·000 | 219 | 1240 |
| * Jenks's carbine, . . | " | 70 | ·000 | 219 | 1687 |
| Cadet's musket, . . . | Flint. | 70 | ·045 | 219 | 1690 |
| Pistol, . . . . | Percussion. | 35 | ·015 | 218·5 | 947 |

* Loaded at the breach.

*Practical Deductions of Captain Mordecai, suggested by his Experiments.*

*Proof of Powder.*—The common eprouvettes are of no value as instruments for determining the relative force of different kinds of gunpowder.

In the proof of gunpowder a cannon pendulum should be used.

In a 24-pounder gun, new cannon powder should give, with a charge of 6lbs., an initial velocity of not less than 1600 feet to a ball of medium weight and windage.

For the proof of powder for small arms, a small ballistic pendulum is best adapted.

The initial velocity of a musket ball (18 to the pound), of 0·05 inches windage, with a charge of 120 grains, should be:

With new musket powder, not less than 1500 feet.

With new rifle powder, not less than 1600 feet.

With fine sporting powder, not less than 1800 feet.

*Manufacture of Powder.*—The powder of greatest force, whether for cannon or small arms, is produced by incorporation in the "cylinder mills."

*Effect of Wads.*—In the service of *cannon*, heavy wads over the ball are in all respects injurious.

For the purpose of retaining the ball in its place, light *grommets* should be used.

On the other hand, it is of great importance, and especially so in the use of small arms, that there should be a good wad over the powder for developing the full force of the charge, unless, as in the rifle, the ball has but very little windage.

*Effect of the Size of the Grain.*—Within the limits of the difference in the size of grain, which occurs in ordinary cannon powder, the granulation appears to exercise but little influence on the force of it, unless the grain be exceedingly dense and hard.

*Effect of Glazing.*—Glazing is favorable to the production of the greatest force, and to the quick combustion of the grains, by affording a rapid transmission of the flame through the mass of the powder.

*Effect of Using Percussion Primers.*—The increase of force by the use of primers, *which nearly closes the vent*, is constant and appreciable in amount, yet not of sufficient value to authorize a reduction of the charge.

*Bore, Weight of Charges, and Ranges for U. S. Small Arms.*

| Kind of arm. | Bore. | Windage of ball. | Powder. | Ball. | |
|---|---|---|---|---|---|
| | Inches. | Inches. | Grains. | | |
| Musket, . . | ·69 | *·05 | 120 | 397·5 grains. | Wad, 10·2 grs. |
| " . . | ·69 | †·04 | 110 | 410·2 " | " 10·2 " |
| Rifle, . . | ·54 | ·525 | 75 | 218·5 " | " 8·4 " |
| Pistol, . . | ·54 | ·525 | 35 | 218·5 " | " 5·5 " |
| " . . | ·54 | ·525 | 30 | 218·5 " | " 5·5 " |

* 0·05679 lbs., or 18 to the pound. † 0·05861 lbs., or 17 to the pound.

### *Range for Small Arms.*

*Musket.*—With the ball of 17 to the pound, and a charge of 110 grains of powder, &c., an elevation of 36′ is required for a range of 200 yards; and for a range of 500 yards, an elevation of 30° 30′ is necessary, and at this distance the ball will pass through a pine board 1 inch in thickness.

*Rifle.*—With the charge of 70 grains, an effective range of from 300 to 350 is obtained; but as 75 grains can be used without *stripping* the ball, it is deemed better to use it, to allow for accidental loss, deterioration of powder, &c.

*Pistol.*—With the charge of 30 grains, the ball is projected through a pine board 1 inch thick at a distance of 80 yards.

### *Proof of Powder.*

*Ordinary Proof of Powder.*—One oz. with a 24 lb. ball. The mean range of new, proved at any one time, must not be less than 250 yards; but none ranging below 225 yards is received.

Powder in magazines that does not range over 180 yards is considered unserviceable.

*Good* powder averages from 280 to 300 yards; *small grain*, from 300 to 320 yards.

DIMENSIONS OF POWDER BARRELS.

| | |
|---|---|
| Whole length, | 20·5 inches. |
| Length, interior in the clear, | 18· " |
| Interior diameter at the head, | 14· " |
| " " bilge, | 16· " |
| Thickness of staves and heads, | ·5 " |
| Weight of barrels about | 25 lbs. |

## LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

SUPREME COURT OF THE UNITED STATES.

### *Lead Pipe Case.*

Thomas Otis Le Roy & David Smith, *Plffs. in er.* vs. Benjamin Tatham, Jr., George N. Tatham, and Henry B. Tatham. } *In error to the Circuit Court of the United States for the Southern district of New York.*

OPINION OF JUSTICE NELSON.

The patent in this case, according to the general description given by the patentees, is, for improvements upon, and additions to the machinery or apparatus of Thomas Burr for manufacturing pipes and tubes from metallic substances. They declare, that the nature of their invention and the manner in which the same is to operate, are particularly described and

set forth in their specification. In that, they refer to the patent of Burr of the 11th of April, 1820, for making lead pipe out of set or solid lead by means of great pressure, the product being wrought pipe, as contra-distinguished from cast or pipe made according to the draw-bench system. The apparatus, as described by Burr, consisted of a strong iron cylinder, bored sufficiently true for a piston to traverse easily within it. This cylinder was closed at one end by the piston, and also closed at the other except a small aperture for the die which formed the external diameter of the pipe. The core or mandril, which determined the inner diameter, was a long cylindrical rod of steel, one end of which was attached to the face of the piston, extending through the centre of the cylinder, and passing also through the centre of the die at the opposite end, leaving a space around the core and between it and the die for the formation of the pipe. The metal to form the pipe was admitted into the cylinder in a fluid state, and when it becomes set or solid, the power of a hydraulic press was applied to the head of the piston, which moving against the body of solid lead in the cylinder drove it through the die, the long core advancing with the piston and with the body of lead through the die, and thus forming the pipe. The cylinder usually holds from three to four hundred pounds of lead, and continuous pipe is made till the whole charge is driven out.

This plan, though one of deserved merit, and of great originality, failed, when reduced to practice, except for the purpose of making very large pipe, larger than that usually in demand, and consequently passed out of general use. The long core attached to the face of the piston advancing with it in the solid lead under the great pressure required, was liable to warp and twist out of a straight line, and out of centre in the die, which had the effect to destroy the uniformity of the thickness and centrality of the bore of the pipe.

The old mode therefore of making pipe by the draw-bench system continued down to 1837, when the patentees in this case discovered by experiment that lead when recently set and solid, but still under heat and extreme pressure in a close vessel, would reunite after a separation of its parts, and "heal (in the language of the patentees) as it were by the first intention," as completely as though it had not been divided.

Upon the discovery of this property of lead, which had never before been known, but on the contrary, had been supposed and believed by all men of science skilled in metals, to be impossible, the patentees made an alteration in the apparatus of Burr founded upon this new property discovered in the metal, and succeeded completely in making wrought pipe out of solid lead by means of the hydraulic pressure. The product was so much superior in quality to that made according to the old mode, that it immediately wholly superseded it in the market. The pipe was also made much cheaper.

The patentees by their discovery were enabled to dispense with the long core of Burr, and to fix firmly a bridge or cross bars at the end of the cylinder near the die, to which bridge they fastened a short core extending into and through the die. By this arrangement they obtained a firm, immovable core, that always preserved its centrality with the die,

and secured the manufacture of pipe of uniformity of thickness of wall and accuracy of bore of any dimension. The lead after being admitted into the cylinder in a fluid state, was allowed to remain till it became solid, and was then driven by the piston through the apertures in the bridge into the chamber between it and the die, where the parts reunited after the separation as completely as before, and passing out at the die around the fixed short core, formed perfect pipe.

The patentees state, that they do not intend to confine themselves to the arrangement of the apparatus thus particularly specified, and point out several other modes by which the same result may be produced, all of which variations would readily suggest themselves, as they observe, to any practical engineer without departing from the substantial originality of the invention, the remarkable feature of which, they say, is, that lead when in a set state, being yet under heat, can be made by extreme pressure to re-unite perfectly around a core after separation, and thus be formed into strong pipes or tubes. Pipes thus made are found to possess great solidity and unusual strength, and a fine uniformity, such as had never before been obtained by any other mode. The essential difference in its character, and which distinguishes it from all other theretofore known, they add, is that it is wrought under heat by pressure and constriction from set or solid metal.

They do not claim as their invention or improvement any of the parts of the machinery, independently of the arrangement and combination set forth.

"What we claim as our invention, they say, is, the combination of the following parts above described, to wit: the core and bridge or guide piece, with the cylinder, the piston, the chamber, and die, *when used to form pipes of metal under heat and pressure in the manner set forth, or in any other manner substantially the same.*"

It is supposed that the patentees claim as the novelty of their invention the arrangement and combination of the machinery, which they have described, disconnected from the employment of the new property of lead which they have discovered, and by the practical application and use of which they have succeeded in producing the new manufacture. And the general title or description of their invention given in the body of the letters patent is referred to as evidence of such claim. But every patent, whatever may be the general heading or title by which the invention is designated, refers to the specification annexed for a more particular description; and, hence, this court has heretofore determined that the specification constitutes a part of the patent, and that they must be construed together when seeking to ascertain the discovery claimed. (6 How. 437, Hogg et al. vs. Emerson.)

The same rule of construction was applied by the court of exchequer in England in the case of Neilson's patent for the hot air blast. (Webster's Cases 373.)

Now, on looking into the specification, we see, that the leading feature of the invention consists in the discovery of a new property in the article of lead, and in the employment and adaptation of it by means of the machinery described to the production of a new article, wrought pipe, never

before successfully made. Without the discovery of this new property in the metal, the machinery or apparatus would be useless, and not the subject of a patent. It is in connexion with this property, and the embodyment and adaptation of it to practical use, that the machinery is described, and the arrangement claimed. The discovery of this new element or property led naturally to the apparatus by which a new and most useful result is produced. The apparatus was but incidental, and subsidiary to the new and leading idea of the invention. And hence, the patentees set forth, as the leading feature of it, the discovery, that lead in a solid state, but under heat and extreme pressure in a close vessel, will re-unite after separation of its parts as completely as though it had never been separated. It required very little ingenuity, after the experiments in a close vessel, by which this new property of the metal was first developed, to construct the necessary machinery for the formation of pipe. The apparatus essential to develope this property would, at once, suggest the material parts, especially in the state of the art at the time. Any skilful mechanic with Burr's machine before him would readily construct the requisite machinery.

The patentees, therefore, after describing their discovery of this property of lead, and the apparatus by means of which they apply the metal to the manufacture of pipe, claim the combination of the machinery only, when used to form pipes under heat and pressure in the manner set forth or in any other manner substantially the same. They do not claim it as new separately, or when used for any other purpose, or in any other way, but claim it only, when applied for the purpose, and in the way pointed out in the specification. The combination as machinery, may be old; may have been long used; of itself, what no one could claim as his invention, and may not be the subject of a patent. What is claimed is that it never had been before applied or used in the way, and for the purpose they have used and applied it, namely, in the embodyment and adaptation of a newly discovered property in lead by means of which they are enabled to produce a new manufacture—wrought pipe out of a mass of solid lead. Burr had attempted it, but failed. These patentees, after the lapse of seventeen years, having discovered this new property in the metal, succeeded by the use and employment of it, and since then, none other than wrought lead pipe made out of solid lead, has been found in the market, having superseded, on account of its superior quality and cheapness, all other modes of manufacture.

Now, the construction which, I understand, a majority of my brethren are inclined to give to this patent, namely, that the patentees claim as the originality of their invention, simply, the combination of the machinery employed, with great deference, seems to me contrary to the fair and reasonable import of the language of the specification, and, also, of the summary of the claim. The tendency of modern decisions is to construe specifications benignly, and to look through mere forms of expression, often inartificially used, to the substance, and to maintain the right of the patentee to the thing really invented, if ascertainable upon a liberal consideration of the language of the specification when taken together. For this purpose phrases standing alone are not to be singled out, but the whole are to be taken in connexion. (1 Sumn. 482, 485.)

Baron Parke observed, in delivering the opinion of the court in Neilson's patent, "that half a century ago, or even less, within fifteen or twenty years, there seems to have been very much a practice with both judges and juries to destroy the patent right, even of beneficial patents, by exercising great astuteness in taking objections, either as to the title of the patent, but more particularly as to the specification, and many valuable patent rights have been destroyed in consequence of the objections so taken. Within the last ten years or more, the courts have not been so strict in taking objections to the specifications, and they have endeavored to hold a fair hand between the patentee and the public, willing to give the patentee the reward of his patent."

Construing the patent before us in this spirit, I cannot but think, that the thing really discovered, and intended to be described, and claimed by these patentees, cannot well be mistaken. That they did not suppose the novelty of their invention consisted, simply, in the arrangement of the machinery described is manifest. They state distinctly that the leading feature of their discovery consisted of this new property of lead, and some of its alloys—this, they say, is the remarkable feature of their invention—and the apparatus described is regarded by them as subordinate, and as important, only, as enabling them to give practical effect to this newly discovered property by means of which they produce the new manufacture. If they have failed to describe and claim this as belonging to their invention, it is manifest, upon the face of their specification, that they have failed to employ the proper words to describe and claim what they intended, and that the very case is presented, in which, if the court, in the language of Baron Parke, will endeavor to hold a fair hand between the patentee and the public, it will look through the forms of expression used, and discover, if it can, the thing really invented. Applying to the specification this rule of construction, and all difficulty, at once, disappears. The thing invented and intended to be claimed is too apparent to be mistaken.

The patentees have certainly been unfortunate in the language of the specification, if upon a fair and liberal interpretation, they have claimed only the simple apparatus employed; when, they have not only set forth the discovery of this property in the metal as the great feature of their invention, but, as is manifest, without it the apparatus would have been useless. Strike out this new property from their description, and from their claim, and nothing valuable is left. All the rest would be worthless. This lies at the foundation upon which the great merit of the invention rests, and without a knowledge of which the new manufacture could not have been produced; and, for aught we know, the world have been deprived of it down to this day.

If the patentees had claimed the combination of the core and bridge or guide piece with the cylinder, the chambers, and the die, and stopped there, I admit, the construction now adopted by a majority of my brethren, could not be denied; although, even then, it would be obvious from an examination of the specification as a whole, that the draftsmen had mistaken the thing really invented, and substituted in its place matters simply incidental, and of comparative insignificance. But the language of the claim does not stop here. The combination of these parts are claimed,

only, when used to form pipes of lead under heat and pressure in the manner set forth—that is, when used for the embodyment and adaptation of this new property in the metal for making wrought pipe out of a solid mass of lead. This guarded limitation of the use excludes the idea of a claim to the combination for any other, and ties it down to the instance, when the use incorporates within it the new idea or element which gives to it its value; and, by means of which, the new manufacture is produced. How, then, can it be consistently held, that here is a simple claim to the machinery, and nothing more, when a reasonable interpretation of the words not only necessarily excludes any such claim, but in express terms sets forth a different one—one not only different in the conception of the invention, but, different in the practical working of the apparatus to accomplish the purpose intended.

I conclude, therefore, that the claim in this case, is not simply for the apparatus employed by the patentees, but for the embodyment or employment of the newly discovered property of the metal, and the practical adaptation of it by these means to the production of a new result, namely, the manufacture of wrought pipe out of solid lead.

Then, is this the proper subject matter of a patent?

This question was first largely discussed by counsel and court in the celebrated case of Boulton vs. Bull, (2 Hen. Bl., 463,) involving the validity of Watt's patent, which was for "a new invented method for lessening the consumption of fuel and steam in fire engines." This was effected by enclosing the steam vessel or cylinder with wood, or other material, which preserved the heat in the steam vessel: and by condensing the steam in separate vessels. It was admitted, on the argument, that there was no new mechanical construction invented by Watt, and the validity of the patent was placed on the ground that it was for well known principles practically applied, producing a new and useful result. On the other hand, it was conceded, that the application of the principles in the manner described was new, and produced the result claimed; but it was denied that this constituted the subject matter of a patent. Heath and Buller, justices, agreed with counsel for the defendant. But Lord Chief Justice Eyre laid down the true doctrine, and which, I think, will be seen to be the admitted doctrine of the courts of England at this day. "Undoubtedly, he observed, there can be no patent for a mere principle; but for a principle so far embodied and connected with corporeal substances as to be in a condition to act, and to produce effects in any art, trade, mystery, or manual occupation, I think, there may be a patent. Now this, he continues, is, in my judgment, the thing for which the patent stated in the case was granted, and this is what the specification describes, though it miscalls it a principle. It is not that the patentee conceived an abstract notion that the consumption of steam in fire engines may be lessened, but he has discovered a practical manner of doing it; and for that practical manner of doing it he has taken this patent. Surely, he observes, "this is a very different thing from taking a patent for a principle." The apparatus, as we have said, was not new. "There is no new mechanical construction," said the counsel for the patentee, "invented by Watt capable of being the subject of a distinct specification; but his discovery was of a principle, the method of applying which is clearly set forth." Chief Justice Eyre

admitted that the means used were not new, and that if the patent had been taken out for the mechanism used, it must fail.

He observed, "when the effect produced is some new substance or composition of things, it should seem that the privilege of the sole working or making ought to be for such new substances or composition without regard to the mechanism or process by which it has been produced, which, though perhaps also new, will be only useful as producing the new substances." Again, "when the effect produced is no new substance, or composition of things, the patent can only be for the mechanism, if new mechanism is used; or for the process, if it be a new method of operating, with or without old mechanism, by which the effect is produced." And again, he observes, "if we wanted an illustration of the possible merit of a new method of operating with old machinery, we might look to the identical case before the court."—p. 496, 493, 495.

This doctrine, in expounding the law of patents, was announced in 1795, and the subsequent adoption of it by the English courts, shows that Chief Justice Eyre was considerably in advance of his associates upon this branch of the law. He had got rid, at an early day, of the prejudice against patents so feelingly referred to by Baron Parke in Neilson vs. Harford, and comprehended the great advantages to his country if properly encouraged. He observed, in another part of his opinion, that "the advantages to the public from improvements of this kind are beyond all calculation important to a commercial country, and the ingenuity of artists who turn their thoughts towards such improvements is, in itself, deserving of encouragement."

This doctrine was recognised by the Court of King's Bench in the King vs. Wheeler. (2 B and Ald. 340. 350.)

It is there observed, that the word "manufactures" in the patent act may be extended to a mere process to be carried on by known implements or elements, acting upon known substances, and ultimately producing some other known substance, but producing it in a cheaper or more expeditious manner, or of a better or more useful kind.

Now, if this process to be carried on by known implements acting upon known substances, and ultimately producing some other known substance of a better kind, is patentable, a fortiori, will it be patentable, if it ultimately produces not some other known substance, but an entirely new and useful substance?

In Forsyth's patent, which consists of the application and use of detonating powder as priming for the discharge of fire arms, it was held that whatever might be the construction of the lock or contrivance by which the powder was to be discharged, the use of the detonating mixture as priming, which article of itself was not new, was an infringement. (Webster Pt. Cas. 94, 97, (n). Curtis on pt. 230.

This case is founded upon a doctrine which has been recognised in several subsequent cases in England, namely, that where a person discovers a principle or property of nature, or where he conceives of a new application of a well known principle or property of nature, and also, of some mode of carrying it out into practice, so as to produce or attain a new and useful effect or result, he is entitled to protection against all other

modes of carrying the same principle or property into practice for obtaining the same effect or result.

The novelty of the conception consists in the discovery and application in the one case, and of the application in the other, by which a new product in the arts or manufactures is the effect; and the question in case of an infringement, is, as to the substantial identity of the principle or property; and of the application of the same, and consequently the means or machinery made use of, material only so far as they affect the identity of the application.

In the case of Jupes patent for "an improved expanding table," Baron Alderson observed, speaking of this doctrine, "you can not take out a patent for a principle; you may take out a patent for a principle coupled with the mode of carrying the principle into effect. But then, you must start with having invented some mode of carrying the principle into effect; if you have done that, then you are entitled to protect yourself from all other modes of carrying the same principle into effect, that being treated by the jury as piracy of your original invention." (Webster's pt. cases, 147.) The same doctrine was maintained also in the case of Neilson's patent for the hot air blast in the K. B. and Exchequer in England. (Webster's pt. cases, 342, 371.) Curtis §74, 148, 232. Webster's pt. cases 310.

This patent came also before the Court of Sessions in Scotland, and in submitting the case to the jury the Lord Justice remarked, "that the main merit, the most important part of the invention, may consist in the conception of the original idea—in the discovery of the principle in science, or of the law of nature, stated in the patent; and little or no pains may have been taken in working out the best mode of the application of the principle to the purpose set forth in the patent. But still, if the principle is stated to be applicable to any special purpose, so as to produce any result previously unknown, in the way and for the objects described, the patent is good. It is no longer an abstract principle. It becomes to be a principle turned to account, to a practical object, and applied to a special result. It becomes, then, not an abstract principle which means a principle considered apart from any special purpose or practical operation, but the discovery and statement of a principle for a special purpose, that is, a practical invention, a mode of carrying a principle into effect. That such is the law, he observes, if a well known principle is applied for the first time to produce a practical result for a special purpose, has never been disputed, and it would be very strange and unjust to refuse the same legal effect when the inventor has the additional merit of discovering the principle, as well as its application to a practical object.

Then he observes, again, is it an objection to the patent that in its application of a new principle to a certain specified result, it includes every variety of mode of applying the principle according to the general statement of the object and benefit to be attained? This, he observes, is a question of law, and I must tell you distinctly, that this generality of claim, that is, for all modes of applying the principle to the purpose specified, according to, or within a general statement of the object to be attained, and of the use to be made of the agent to be so applied, is no objection to the patent. The application or use of the agent for the purpose speci-

fied, may be carried out in a great variety of ways, only shows the beauty and simplicity, and comprehensiveness of the invention.

This case was carried up to the House of Lords on exceptions to the charge, and among others, to this part of it, which was the sixth exception, and is as follows: "In so far as he (the judge) did not direct the jury, that on the construction of the patent and specification, the patentee cannot claim or maintain that this patent is one which applies to all the varieties in the apparatus which may be employed in heating air while under blast; but was limited to the particular described in the specification." And although the judgment of the court was reversed in the House of Lords on the eleventh exception, it was expressly affirmed as respects this one. Lord Campbell at first doubted, but after the decision of the courts in England on this patent he admitted the instruction was right. (Webster, pt. cases, 683, 684, 698, 717.)

I shall not pursue a reference to the authorities on this subject any further. The settled doctrine to be deduced from them, I think, is, that a person having discovered the application for the first time of a well known law of nature, or well known property of matter, by means of which a new result in the arts or in manufactures is produced, and has pointed out a mode by which it is produced, is entitled to a patent; and, if he has not tied himself down in the specification to the particular mode described, he is entitled to be protected against all modes by which the same result is produced, by an application of the same law of nature or property of matter. And, a fortiori, if he has discovered the law of nature or property of matter, and applied it, is he entitled to the patent, and aforesaid protection.

And why should not this be the law? The original conception—the novel idea in the one case, is the new application of the principle or property of matter, and the new product in the arts or manufactures—in the other, in the discovery of the principle or property, and application, with like result. The mode or means are but incidental, and flowing naturally from the original conception; and hence of inconsiderable merit. But, it is said, this is patenting a principle or element of nature. The authorities to which I have referred, answer the objection. It was answered by Chief Justice Eyre in case of Watt's patent in 1795, fifty-seven years ago; and more recently in still more explicit and authoritative terms. And what if the principle is incorporated in the invention and the inventor protected in the enjoyment for the fourteen years. He is protected only in the enjoyment of the application for the special purpose and object to which it has been newly applied by his genius and skill. For every other purpose and end, the principle is free for all mankind to use. And, where it has been discovered as well as applied to this one purpose, and open to the world as to every other, the ground of complaint is certainly not very obvious. Undoubtedly, within the range of the purpose and object for which the principle has been for the first time applied, piracies are interfered with during the fourteen years. But any body may take it up and give to it any other application to the enlargement of the arts and of manufactures, without restriction. He is only debarred from the use of the new application for the limited time, which the genius of others has

already invented and put into successful practice. The protection does not go beyond the thing which, for the first time, has been discovered and brought into practical use; and is no broader than that extended to every other discoverer or inventor of a new art or manufacture.

I own, I am incapable of comprehending the detriment to the improvements in the country that may flow from this sort of protection to inventors.

To hold, in the case of inventions of this character, that novelty must consist of the mode or means of the new application producing the new result, would be holding against the facts of the case, as no one can but see, that the original conception reaches far beyond these. It would be mistaking the skill of the mechanic for the genius of the inventor.

Upon this doctrine some of the most brilliant and useful inventions of the day by men justly regarded as public benefactors, and whose names reflect honor upon their country—the successful application of steam power to the propulsion of vessels and railroad cars—the application of the electric current for the instant communication of intelligence from one extremity of country to the other—and the more recent, but, equally brilliant conception, the propulsion of vessels by the application of the expansibility of heated air, the air supplied from the atmosphere that surrounds them. It would be found, on consulting the system of laws established for their encouragement and protection, that the world had altogether mistaken the merit of their discovery; that, instead of the originality and brilliancy of the conception that had been unwittingly attributed to them, the whole of it consisted of some simple mechanical contrivances which a mechanician of ordinary skill could readily have devised. Even Franklin, if he had turned the lightning to account, in order to protect himself from piracies, must have patented the kite, and the thread, and the key, as his great original conception, which gave him a name throughout Europe as well as at home, for bringing down this element from the heavens, and subjecting it to the service of man. And, if these simple contrivances taken together, and disconnected from the control and use of the element by which the new application and new and useful result may have been produced, happen to be old and well known, his patent would be void; or, if some follower in the track of genius, with just intellect enough to make a different mechanical device or contrivance, for the same control and application of the element, and produce the same result, he would, under this view of the patent law, entitle himself to the full enjoyment of the fruits of Franklin's discovery.

If I rightly comprehend the ground upon which a majority of my brethren have placed the decision, they do not intend to controvert so much the doctrine which I have endeavored to maintain, and which, I think, rests upon settled authority, as the application of it to the particular case. They suppose that the patentees have claimed only the combination of the different parts of the machinery described in their specification, and, therefore, are tied down to the maintenance of that as the novelty of their invention. I have endeavored to show, that this is a mistaken interpretation; and, that they claim the combination, only, when used to embody and give a practical application to the newly discovered property in the lead by means of which a new manufacture is produced, namely,

wrought pipe out of a solid mass of lead; which, it is conceded, was never before successfully accomplished.

For these reasons I am constrained to differ with the judgment they have arrived at, and am in favor of affirming that of the court below.

NOTE.—Seven Judges sat upon the hearing of this cause. Mr. Justice Curtis did not sit, and there was one vacancy. Three Justices dissented from the opinion of Mr. Justice McLean, as published in the last number, so that his opinion cannot be said to have received the sanction of a majority of the full Court.

## MECHANICS, PHYSICS, AND CHEMISTRY.

*The U. S. Steamship Saranac.* By B. F. ISHERWOOD, Ch. Eng., U. S. N.

Continued from page 269.

*Statistics of the Machinery of the Saranac.*

| | Weight of materials in a finished state. | Finished surfaces. | Days' labor. | Cost. |
|---|---|---|---|---|
| | Pounds. | Sq. In. | No. days. | $ cts. |
| ENGINES AND BOILER APPURTENANCES, except smoke chimney, grate bars, and brass in bracing, crow feet, &c., | | | | |
| Weight of material in a finished state. | | | | |
| Cast iron, . . 234,151 lbs. | | | | |
| Wrought iron, . 128,949 " | | | | |
| Copper, . . 20,809 " | | | | |
| Brass, . . . 27,010 " | | | | |
| Steel, . . . 1,563 " | | | | |
| | 412,482 | | | |
| Finished Surfaces. | | | | |
| Turning and boring, 434,181 sq. in. | | | | |
| Planing, . . 145,880 " | | | | |
| | | 580,061 | | |
| Days' Labor. | | | | |
| Patterns, . . . 1,622 days. | | | | |
| Laborers, . . . 115 " | | | | |
| Fitters, . . . 9,789 " | | | | |
| | | | 11,526 | |
| Total cost, . . . | | | | 102,381·57 |
| PADDLE WHEELS. | | | | |
| Weight of materials in a finished state. | | | | |
| Wrought iron, . . 52,367 lbs. | | | | |
| | 52,367 | | | |
| Total cost, . . . | | | | 5,760·37 |
| BOILER, smoke chimney, grate bars, &c. | | | | |
| Weight of materials in a finished state. | | | | |
| Cast iron, . . . 15,650 lbs. | | | | |
| Wrought iron, . 16,905 " | | | | |
| | 32,555 | | | |
| Total cost, . . . | | | | 2,836·10 |
| Carried over, | 497,404 | 580,061 | 11,526 | 110,978·04 |

| | Weight of materials in a finished state. | Finished surfaces. | Days' labor. | Cost. |
|---|---|---|---|---|
| BOILERS. | Pounds | Sq.In. | No. days. | $ cts. |
| Amount brought over, | 497,404 | 580,061 | 11,526 | 110,978·04 |
| Weight of materials in a finished state. | | | | |
| Copper bolts and plates, 191,074 lbs. | | | | |
| Brass composition, 16,300 " | | | | |
| | 207,374 | | | |
| Cost of work on boil., $16,241·29 | | | | |
| " copper in " 53,149·90 | | | | |
| " brass in " 5,379·00 | | | | |
| Total cost, . . . | | | | 74,770·19 |
| COAL BUNKERS. | | | | |
| Weight of materials in a finished state. | | | | |
| Wrought iron, . 43,630 lbs. | | | | |
| | 43,630 | | | |
| Total cost, . . . | | | | 5,017·45 |
| EXTRA PIECES, &c. | | | | |
| Weight of materials in a finished state. | | | | |
| Wrought iron, . . 4,257 lbs. | | | | |
| Cast iron, . . . 18,011 " | | | | |
| Brass, . . . . 1,164 " | | | | |
| Copper, . . . . 124 " | | | | |
| Steel, . . . . 4 " | | | | |
| | 23,560 | | | |
| Finished Surfaces. | | | | |
| Turning and boring, 11,961 sq. in. | | | | |
| Planing, . . . 5,554 | | | | |
| | | 17,515 | | |
| Total cost, . . . | | | | 2,169·28 |
| LUMBER FOR PATTERNS. | | | | |
| Pine, . . . 15,181 cu. ft. | | | | |
| Mahogany, . . . 538 " | | | | |
| Total cost, . . . | | | | 627·65 |
| Grand totals, . . . | 741,413 | 597,576 | 11,526 | 194,862·61 |

*Cost of the Saranac.*

| | |
|---|---|
| Hull, . . . . . | $ 150,149·51 |
| Masts and spars, . . . . . | 3,547·57 |
| Boats, . . . . . | 3,240·28 |
| Rigging and blocks, . . . . . | 11,109·28 |
| Sails, . . . . . | 6,295·38 |
| Tanks and casks, . . . . . | 1,697·11 |
| Anchors and cables, . . . . . | 11,544·10 |
| Furniture, . . . . . | 1,917·85 |
| Galley, cooking utensils, &c., . . . . | 2,392·87 |
| Armament, . . . . . | 15,737·64 |
| Machinery, (original bills,) $ 194,862·61 ) Do. (after bills,) 5,849·72 ) | 200,712·33 |
| Stores in the various departments, exclusive of coal, | 16,766·09 |
| Total, . . . . . | $425,102·82 |

*Armament.*—The armament of the *Saranac* consists of two 8-inch guns of 106 cwt. each, mounted forward on pivots; and four 8-inch guns of 55 cwt. each, mounted aft in broadside. The ship's personnel numbers 225 souls.

*Cost of Repairs on the Saranac.*

| | |
|---|---|
| Total amount of repairs done on the machinery from April 1st, 1851, to October 1st, 1852, | $37,133·49 |
| Total amount of repairs done on the hull, armament, rigging, spars, boats, &c., &c., from April 1st, 1850, to October 1st, 1852, | 38,470·83 |
| Making the aggregate cost of repairs from completion, April 1st, 1850, to last fit out, October 1st, 1852, | 75,604·32 |

Time, 30 months, or at the rate of 7·11 per cent. per ann. on first cost.

*Weights of the Saranac.*

| | Tons of 2240 lbs. |
|---|---|
| Hull, | 1037·0 |
| Masts, spars, and sails, | 54·9 |
| Tanks, casks, and water in them, | 30·3 |
| Anchors and cables, | 57·0 |
| Furniture and officers' stores, | 5·1 |
| Stores, provisions, galley wood, &c., | 136·2 |
| Armament, | 63·8 |
| Officers and men, | 20·0 |
| Steam machinery, including water in boilers, | 368·3 |
| Coal in bunkers, &c., | 377·4 |
| Total, | 2150·0 |

Making a load mean draft of 17 feet.

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## *On the Analysis of Cast Iron.* By Professors Campbell Morfit and James C. Booth.

(Extract from the Official Report to Captain L. A. B. Walbach, U. S. Ordnance, on Foundry Service, upon the Examination of Gun Metal.)

Continued from page 257.

### Tin and Titanium.

The filter, *a*, which was set away in the early stages of the process, contained all the silex and slag, tin and titanium, with some carbon. The slag, silex, and carbon, having been determined in previous essays, it was reserved for the estimation of the two remaining components. A qualitative examination is only necessary generally, for in no one of our samples did we find even traces. Still, they may occasionally exist, and must be sought, and if largely present, separated in the usual manner.

7. *Tin.*—If tin existed in the metal, it was converted into insoluble stannic acid by the oxidizing action of the nitric acid and subsequent evaporation, and remained with the insoluble residue. Its presence is proved by fusing the suspected insoluble residue on charcoal with carbonate of soda, grinding that part of the coal in an agate mortar with water, and washing over with water until all the charcoal and other light particles have been removed, when tin will betray itself by silvery spangles and streaks produced by the pestle.

8. *Titanium.*—The presence of titanium is best shown by fusing the whole residue with carbonate of soda, extracting with luke-warm water, filtering, partially neutralizing, and boiling; titanic acid will precipitate.

A yellowish tint in the soda solution will also indicate the presence of chrome.

ARSENIC, ANTIMONY, AND SULPHUR.

As these components, if present, exist in quantities too minute to be estimated from one gramme of metal, a new portion of five grammes of *clippings* must be treated specially for the purpose.

9. *Arsenic.*—These are placed in a beaker of 16 ounces capacity, and drenched with a fluid ounce of pure nitric acid. The glass is covered with an inverted capsule, and very gradually heated to boiling by a small spirit lamp. As the digestion progresses, 13 to 15 grammes of finely powdered chlorate of potassa are added portionwise, and the heat continued until the insoluble particles become flotant, when the digestion is completed. The nitric acid and chlorate of potassa, having eminent oxidizing powers, convert most of the ingredients wholly into a soluble form. The metals being oxidized, their oxides dissolve in the acid, the sulphur and arsenic have become soluble arseniate and sulphate of potassa, and carbon, silex, and slag remain as insoluble residue. The liquor is evaporated to dryness to render silica insoluble, re-digested in hydrochloric acid to remove oxide of iron, &c., diluted with water, filtered, and hot-washed. The filter is rejected, its contents having been already estimated in previous essays. The filtrate is G.

Aqua regia cannot be substituted for the mixture of nitric acid and chlorate of potassa, for the amounts of sulphur and arsenic are so small that portions may be volatilized as gaseous hydrogen compounds. Nitric acid alone is slow in action, and the addition of *fuming* nitric acid to hasten its action, might introduce the very substances it is desired to detect, for that reagent is seldom pure.

If the size and distinctness of the tache formed upon the porcelain in the qualitative essay indicated an appreciable quantity of arsenic, the process must be continued as follows, to separate and estimate it quantitatively.

The filtrate G contains all the ingredients in soluble form, except those separated by the filter, but owing to a large excess of potassa salt, which is difficultly removed, is valuable only for the sulphur and arsenic.

It is difficult to estimate arsenic quantitatively by that modification of Marsh's process, by which the arseniuretted hydrogen is reduced by heating the middle of the exit tube, for a portion of it may escape decomposition, and the black ring of arsenic obtained in the tube beyond the heated part will only represent a fraction of it. It is true, that Lassaigne's improvement, to conduct the excess of gas into a solution of nitrate of silver, recovers the whole of the arsenic, but we believe that a modification of Reinsch's is a more effectual plan.

Strips of planished copper are introduced into the heated filtrate G, until a fresh surface ceases to be tarnished. The strips are then removed, rinsed in distilled water, and, when dried, carefully laid upon a sheet of glazed paper, and the tarnished coating entirely scraped off with a knife. The scrapings, carefully collected, are introduced into a long and narrow glass tube, and heated to sublime the arsenic as arsenious acid. The upper part of the tube, containing the sublimate, is then cut off, and with

its contents accurately weighed. The arsenious acid having been removed by hydrochloric acid and water, the empty tube is dried, and again weighed. The difference in weight expresses the amount of arsenious acid in the filtrate, whence the metallic arsenic is calculated. A more critically accurate method would be to dissolve the scrapings in nitromuriatic acid, and to estimate the arsenic acid from the filtered solution by a given weight of metallic iron, as directed for phosphorus.

10. *Antimony.*—The only two substances in cast iron precipitated by the metallic copper are arsenic and antimony, and as the two are frequently associated, and give similar metallic stains, we thought it advisable in estimating one to test for the presence of the other. This was done by adding to the tache on the china a concentrated solution of iodate of potassa, which, according to Slater, (*Chem. Gaz.*, ix. 57,) reddens and immediately dissolves arsenical stains; while upon those of antimony it exerts no visible action for several hours. Chlorinated soda or lime will also instantly dissolve arsenic, and leave the antimony.

11. *Sulphur.*—If the tache did not indicate an appreciable quantity of arsenic, the preceding manipulations may be omitted; otherwise, after it has been separated, as above directed, chloride of barium is poured into the residual liquor, the whole stirred, and left to repose for several days. If the content of sulphur is very minute, cloudiness does not manifest itself for several hours, and in such cases a week's repose is necessary to insure the entire subsidence. It must then be filtered off, washed with diluted hydrochloric acid and hot water, ignited, weighed, and the amount of sulphur calculated from the weight of sulphate of baryta.

It is proper to observe, in order to provide against the possibility of error, that some caution is necessary as to the nature of the precipitate; for if the solution be concentrated, a portion of the chloride of barium, which is generally added in excess, may ultimately fall in fine crystalline powder, but it will disappear during washing on the filter. The previous acidulation of the liquid prevents the precipitation of carbonate, phosphate, or arseniate of baryta.

### Nitrogen, Oxygen, and Aridium.

*Nitrogen.*—The doubts of many of the best chemists as to the presence of this element in cast iron, having been confirmed by the recent experiments of a careful investigator, we omitted searching for it.

*Oxygen.*—We doubt the presence of oxygen as an essential ingredient of recently made metal, except in the minute portions of slag accidentally remaining in it, and which sometimes contains a silicate of the oxide of iron.

*Aridium.*—Aridium, said to have been found in some Swedish ores, was not observed by us in our examination.

*August* 8, 1852.

Erratum.—On page 200, in first column, top line, for "*strong* acid," read "*weak* acid."

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For the Journal of the Franklin Institute.

## *On Kemp's Gas Thermostat.* By Charles M. Wetherill, Ph. D., M. D.

Kemp describes in the *Chemical Gazette*, vol. viii. p. 184, (1850,)* a very convenient apparatus for regulating the heat of a gas burner, which

* See Journ. Frank. Inst., Vol. xx., Third Series, p. 336.

deserves a cordial welcome by chemists who have lost their time, patience, and frequently their analysis, by the use of the air bath described in the works on analysis. A great drawback probably to the introduction of Kemp's thermostat, is the use of a platinum tube, which he was at last obliged to add, after several inefficient attempts to avoid it. To those who have not seen Kemp's description, it may be necessary to state, that it is an air thermometer, placed in the space to be heated, and so regulated by a tube connected with the gas pipes, that the mercury rising to a certain point in the air thermometer, will close the extremity of the said tube, and thus shut off the supply of gas from its burner, which is fed from a tube leading from the upper part of the air thermometer. The tube slides in a brass stuffing box, and when the temperature has reached the required point, (as shown by a thermometer,) it is pushed down to the level of the mercury, so as to shut off the supply of gas. To avoid the light being extinguished, a small hole is bored in the sliding tube, an inch above its extremity. An inspection of the accompanying figures will make this

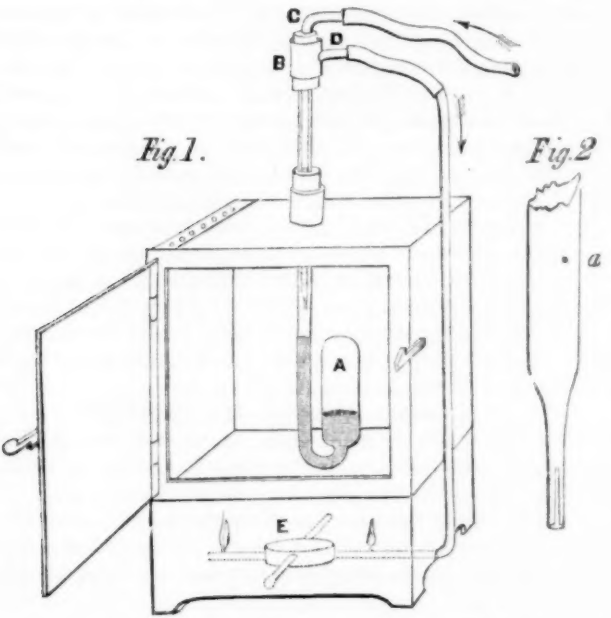


*Fig. 1.* *Fig. 2*

plain. The difficulty Kemp found in employing other tubes than platinum, arose from inefficient contact where no amalgamation ensued, thus suffering the heat to rise "many degrees above the assigned limit;" while copper and brass tubes quickly dissolved in the mercury, rendering it impure, "so that its rise and fall could not be depended upon with the required nicety."

I have found no difficulty in using a glass tube in the place of platinum. Its adaptation depends upon a very simple alteration, namely, of drawing out the extremity. By this means, the extremity of the tube comes in the

centre of the rising column of mercury, which closes it accurately. In order to effect this the more surely, the part drawn out is $\frac{1}{16}$-inch diameter, and of the same diameter for about $\frac{3}{4}$-inch. A quarter of an inch from its extremity is broken up carefully with a very fine angular file. It will be scarcely possible, with glass tubes, to make this slit sufficiently fine that the light be shut off gradually, as Mr. Westly proposes, (*Chemical Gazette*, vol. VIII. p. 239;) since the area of opening necessary to heat an air bath of ordinary size is very small; but the mercury reaching the glass for a short distance before closing the aperture, enables a very accurate closure. When the column of mercury in this tube is barely sufficient to stop the supply of gas, it lowers the flame somewhat, and by a very rapid opening and closing of part of the hole, gives rise to a humming noise, thus attracting attention to the apparatus. The supply of gas should be so regulated that only a slight excess be allowed for variations of pressure. The intervals of this tone will thus become longer and longer, and the temperature will remain constant. Of course, a too great supply of gas, causing the mercury to rise several lines above the aperture of the sliding tube, will render the equilibrium which takes place between the area of this aperture and the required temperature an unstable one, and liable to be disturbed by any sudden cooling effect. The above mentioned tone, therefore, is not without its use, in calling attention to the apparatus until it be regulated properly.

I have had two of these apparatus in use for some time. One is placed in the oven under my sand bath, (which is a large one heated by gas burners.) When the sand bath is not in operation, the sinking of the mercury in the air thermometer raises the lights in the oven. This thermostat worked well, and gave a constant temperature, both when the sand bath was used and when it was out of action.

The other is adapted to an air bath. This very convenient form of air bath (fig. 1) is described in all the works of Analysis that I have seen as necessary to be brazed. This is not at all important, and adds considerably to its expense; a few rivets will answer the purpose equally well, and the chemist may make it himself. The top, bottom, and sides are of one piece, riveted together, the edges being turned down behind and before, to rivet in the back and for the door. A represents the air thermometer, which is of glass. It is convenient to add sufficient mercury, that when the temperature inside the bath is at the height at which it is generally used, the mercury column is visible outside the stove. Instead of Kemp's form of stuffing box, B is best made of a piece of brass tube, to which a smaller one, D, is soldered; the sliding tube, C, and the long stem of A are easily adapted by means of perforated corks. The gas enters at C, and finds its way through the open extremity to the long stem of the air thermometer, from which it passes to the burner at D. This burner is conveniently made by brazing two brass tubes in the form of a cross, and so that their bore communicates; the ends being closed, four holes are made with a drill formed from a needle. The dimensions of the burner are such, that each flame is at a distance from the side of the oven equal to a quarter of its linear dimension. This gives great regularity to the heat. A piece of lead, E, cast upon the intersection of the cross, will serve to steady the burner, and to give air to the flame, by

permitting the circulation of air from beneath. A box, four inches in height, upon which the oven rests, encloses the flame; in it an opening, with a movable cover, is left, to light the gas and watch the flame when necessary. The top of the oven has an additional opening, for the insertion of a thermometer, to regulate the heat when adjusting the sliding tube.

Fig. 2 represents the end of the sliding tube in its proper size. The hole, *a*, through which the gas passes to the burner when the extremity is closed, must be of such a size that merely enough gas passes to prevent the extinction of the light. It is made by heating the tube by a pointed flame, and touching it with a red-hot platinum wire, by which means a small tube may be drawn out, which when broken leaves a small hole; this hole is then melted together in the flame until after trial in the apparatus it is found small enough.

I found no difficulty in keeping within a degree of the temperature required; of course, the delicacy of the apparatus is in proportion to the difference between the contents of the air receiver and the diameter of the long arm of the air thermometer, and owing to increase of pressure, the higher the mercury in this arm the more slowly will it rise by increase of temperature.

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For the Journal of the Franklin Institute.

*Explosions on board the Steamers Fusileer and Shreveport.* By A. C. Jones.

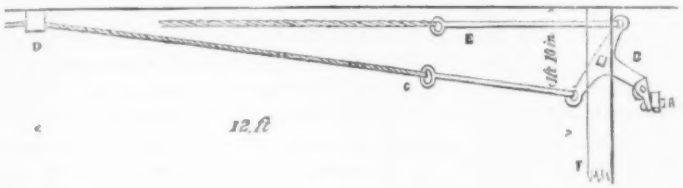
To the Committee on Publications.

Gentlemen:—In the early part of January, an explosion took place on board the Attakapas packet *Fusileer*. It occurred in the Gulf, a short time after leaving the Mississippi river, on her way to Attakapas, and is said to have been caused by gross mismanagement, coupled with drunkenness. The boat was towed to her place of destination, thereby evading an examination into the causes which resulted in the loss of life. This was the first in this vicinity under the new law; and of the second I will now furnish you with the particulars.

The steamer *Shreveport*, on the 20th, in attempting to back out from a landing on Red river, collapsed the inside flue of the larboard boiler, scalding the second engineer and carpenter, who were aft on duty, and injuring a fireman, who was firing at the time.

The boat has a stern wheel, and the engines and "doctor" are consequently near the stern of the boat, leaving about fifty feet space between them and the after ends of the two boilers. The steam gauge, capable of indicating 200 pounds to the square inch, is connected with the steam pipe above where it branches to the engines. There is here also a supplemental screw valve and pipes for blowing off steam from the boilers through the main steam pipe; this valve had been put on the trip before. A small steam drum connects the two boilers at the after end, the safety valve being over the starboard boiler, and the steam pipe over the larboard one. The accompanying sketch gives the contrivance for either raising or holding the end of the safety valve lever down, and is of the

roughest description of workmanship. Where it is attached to the end of the safety valve lever, it gives eight leverages, the fixed weight inside of it being $7\frac{1}{2}$ to 1. Cords from each end of the bent lever pass through small holes in three wooden cleats, (out of line with each other sideways,) fastened to the carlins above.




*a*, end of safety valve lever; *b*, bent lever, each arm is $8\frac{1}{2}$ inches long; *c*, small rod and cord for holding the lever down; *d*, first wooden cleat; *e*, cord for raising lever; *f*, stancheon through which the bent lever works.

At D, in the sketch, it will be seen that the angle of the cord for holding the lever down is considerable, and yet there is no rounding of the small hole to compensate for this deviation from a straight line; the lines finally pass over two-inch sash pulleys down to the side of the starboard engine. To the end of the cord for holding down the valve, is tied *permanently* the half of a cam, (about 30 lbs.) Now, one pound on the end of this cord, by its zigzag course and swelling by the wet weather, which has prevailed for some time past, and the roughness of all the parts in connexion with it, will give many pounds on the end of the lever; in fact, to all intents and the purposes of a safety valve, making it useless, *the valve being perfectly locked.*

This was the first trip of both engineers on this boat, and they were fully provided with certificates from the inspectors of this place, attesting their competency!

The boat had stopped at a landing over fifteen minutes, and steam had been blown off *only* through the valve mentioned, which is too small for the purpose, as it could not discharge steam as fast as the boilers could make it. *They had stopped blowing for about two minutes*, and before a part of a turn of the wheels was made to back out, the flue collapsed, and most of the water was discharged aft. The boilers have been about four months in use.

On examination, I found the flue to be flattened nearly vertically its whole length, and lying up against the other flue. It is partly torn off from the after wrought iron head; the other end is half torn off in the lap, a quarter sheet in length from the head, which is much "buckled," apparently by the great pressure on its surface.

The flues are fourteen inches in diameter; the iron is *three-sixteenths* of an inch in thickness, and is of a medium quality. There is a two inch water space between the flue and the shell. Each boiler has three gauge cocks, the lowest one being about one inch above the tops of the flues; the water line is well defined, and is above the lower gauge cock. That there was plenty of water at the time, is borne out by the appearance of things around, and by the fact of the men at the engines, fifty feet from

the boilers, being scalded, although they were partially protected by a large quantity of freight on the deck.

The true cause was a pressure exceeding the resistance of flues of this diameter, only three-sixteenths of an inch in thickness.

I have before given my opinion of the impropriety of having the water space between the flue and shell so small; and although in this case it was two inches, being more space than a great many boilers in use have, yet the collapsed flue bears evidence of the softening effect, from the great amount of steam bubbles forming on its surface, or the repulsion of the water from this contracted space by the action of the fire on both its sides.

It is said that the inspectors have revoked the certificates of both engineers. This is no more than right; but it is rather late to punish these persons after the injury is done, considering the very loose manner in which "qualified engineers" were made. The inspectors have directed a new flue of the same thickness to be put in; so that it is probable that these boilers may be heard from again.

The new law giving ample power to the inspectors over the details of the boilers, there will be some hope of the removal of the cast iron steam connexion pipes, used on many of the boats of this section, some of which, in addition to the unavoidable settling of the boilers, use these cast iron pipes or steam drums *for the stancheons to set on* for the support of the cabin floor, this part of which is often used for the stowage of the trunks and light freight of the passengers. Several instances have come under my notice of the breaking of these pipes, in which loss of life resulted therefrom.

*New Orleans, March* 26, 1853.

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For the Journal of the Franklin Institute.

## *Flying—Balloon—Parachutes.*

When will the flying of insects and of birds be taken up for investigation by naturalists; or are the mechanisms and actions of their wings—than which no department of natural science offers stronger inducements—to be still thrown aside for the determination of species and genus, and to the accumulation of technical and minute details that have no bearings on truths precious to the engineer. It is marvelous that they have been so long neglected, and the more so, that few zoologists, if any, are yet awake to the fact that the contrivances by which power is conveyed and applied through the organs of motion in animals, involve mechanical novelties and problems in physics of surpassing interest and lasting value. Had they been appreciated, their solution had been attempted ere now. But a spirit of inquiry has arisen, and the demands for practical science have been so urgent, that the laws which govern the flight of birds through the air, and of fishes through water, cannot be much longer neglected. And certainly, on more pleasing and profitable fields of discovery neither the natural nor the mechanical philosopher never entered.

Obvious, palpable, and ever occurring, as are the movements of birds and insects in the atmosphere, there is much in them that is inexplicable; much at all events which I cannot explain; whilst the constant repetition

of these movements, their apparent simplicity and their wonderful variety,—every species having paces or flights and manœuvres peculiar to themselves,—give piquancy to one's curiosity. Look at those pigeons as they sweep down to the street, and back again to their cotes on the church roof; don't their wings appear to move far too slow in the thin and yielding medium, to account for the velocity of their bodies through it? To go at the rate they do, every stroke should be as effective as the leap of a kangaroo; but observe, they flap them rather vertically than in the direction of flight; and therein is not the least difficulty to be got over. Some persons may imagine every thing plain and transparent, but I am almost sure they have never given close and prolonged attention to the subject, nor attempted to trace the various movements to their first principles.

Another perplexity is, how the upward strokes do not neutralize the effect of the downward ones, as in the waving of a fan, in which the resistance is the same in both directions. It cannot be that as much power is expended in elevating the wings as in giving effect to their downward strokes, for that would be consuming half the force to no useful purpose, a defect not allowable in artificial machines, and which unquestionably belongs to no natural one. The explanation is far from being obvious. As for the idea that the pinions act as valves, by opening when the wing is rising to let the air through, and closing when its movement is reversed, I have not been able to detect the process in practice, though this may be due to distance and imperfect vision. Still, no such device is essential to flying, since nothing of the kind can take place with bats, butterflies, house flies, flying-fish, and other soarers whose organs of flight are continuous or unbroken sheets. There is no doubt something like a sculling action—a drawing forward of the organs, edgewise, to repeat the strokes; though how even this is done, is not very perceptible. It is supposed, that the slight convexity of the upper surfaces, and corresponding cavity of the under sides, contribute somewhat to the result. Probably they do, but it cannot be much. The downward flaps are, it is believed, not made quicker than the upper. I have often noticed, and not without surprise, old weather-beaten crows passing quickly along, with one or more feathers out of their wings, and the rest more or less jagged and damaged; and have been almost ready to suspect the existence of an unknown element of buoyancy or of progression, or of both, to account for the phenomenon. Be this as it may, there *are* secrets in the flight of birds and insects, and their disclosure will contribute some exquisite additions to mechanical science.

As regards *Ballooning*, an idea that has often thrust itself on my attention is submitted to the consideration of æronauts. It is this:—instead of an immense inflated sphere, or spheroid, adopt two, three, or more cylindrical and *vertical* tubes, long and closed on the upper ends, charge them with hydrogen gas, and connect their lower ends to a light wooden shaft, furnished with a ratchet and a crank or spokes to turn it, *i. e.* to a windlass fixed in the car. By this arrangement, the means of ascending and descending are secured; for by winding up more or less of the tubes on the windlass, their ascensional power would be diminished, the gas being driven by the act of winding into the upper or floating portions:

while by letting out more, the levity of the whole would be increased; although this mode would not facilitate lateral progress, (and lateral progress of balloons by artificial means has not yet been, if it ever be attained, except in still atmosphere,) it gives the æronaut the power of ascending and descending without loading his apparatus with ballast, and that is something, besides enabling him to reduce the dimensions of balloons. The tubes might of course be inclosed in the usual netting, and a single one might be sufficient for connexion with the windlass.

*Parachutes.*—Cannot these be made to come down uniformly and without violence? Can either form or motion, or both, be given them that will cause them to descend, in a circuitous instead of a direct path, and thereby prolong the time of their descent? These questions are to some extent answered by the following experiment:—Take a slip of letter paper, an inch or an inch and a half long, and $\frac{1}{4}$ or $\frac{3}{8}$ inch wide; let it fall endwise from your fingers, when it will reach the floor at once, and almost in a straight line: but stand on a chair, and let it drop horizontally from near the ceiling, and it will turn rapidly on its longer axis, and will descend to the carpet in a wide spiral of several turns. It will be three, five, or ten times longer in the air than when it falls without turning on its axis. The faster it turns the longer is it detained in the helical orbit of its descent. (To insure its evolution on its axis, a slight twist in opposite directions might be given to the slip; but this is hardly necessary in small pieces.)

Some important truths may receive illustration from this simple experiment, but the question here is, can the principle evolved be applied with advantage to parachutes? I think it can—for if they and more or less of their appendages, be composed of light revolving slats, the result sought for would at least be partially attained. Now there is no great difficulty in substituting such slats for the cloth or silk covering of parachutes, of introducing strings of them between a parachute and its car, and if need be of attaching them to the latter itself; but it is the principle, not details of its application, to which the attention of those who have faith in the navigation of the firmament is invited.

E.

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For the Journal of the Franklin Institute.

*Notes on the U. S. Steamship Powhatan.* By B. F. Isherwood, Chief Eng., U. S. Navy.

The following particulars in relation to this vessel will be of interest, in connexion with the article under the same title in the last February No. of this Journal.

Before leaving Norfolk, Va., (after the steaming recorded in the Feb. number,) an alteration was made by the Chief Engineer, Mr. George Sewell, in the arrangement of the valve gear, for the purpose of obtaining better results. The accompanying indicator diagrams were taken as the vessel was bound out, and sent back to me by the Pilot. By comparing them with the indicator diagrams in the February number, a very great improvement will be observed; the exhaust end of the diagram is much squarer, and the condensation reaches its maximum much sooner.

The paddle wheels had been increased 8 inches in diameter, to give them greater dip. Sea smooth, weather calm.

*Diagram No.* 1.—Revolutions of the wheels, 10½ per minute; steam pressure in boilers above atmosphere per square inch, 10½ lbs.; throttle, ⅜ths open; back pressure in condensers per gauge per square inch, 2·2 lbs.; temperature of hot well, 98° F.

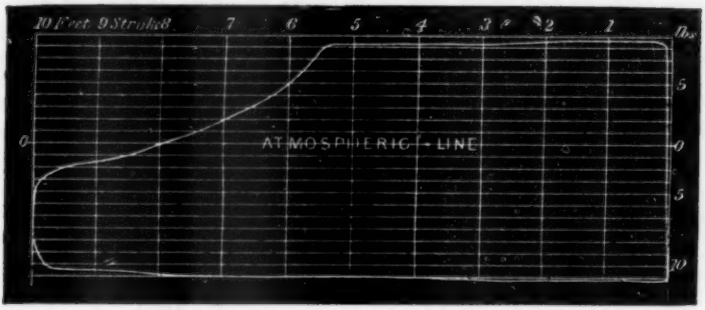
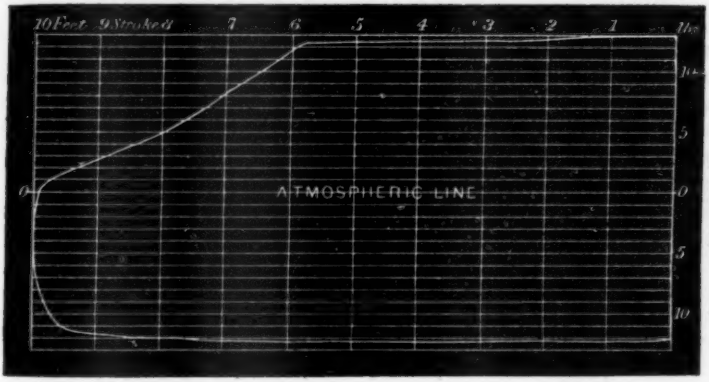



*Diagram No.* 2.—Revolutions of the wheels, 11 per minute; steam pressure in boilers above atmosphere per square inch, 15 lbs.; throttle, ¼th open; back pressure in condensers per gauge per square inch, 2·2 lbs.; temperature of hot well, 100° F.




At my request, the temperature of the smoke chimney was taken; the thermometer was put in a few feet above the top of the steam chimney, and stood with bright fires in the furnace at 452° F. Calculated from this temperature by Buchanan's formula, the velocity of the draft would be 33·54 feet per second. The length of travel of the heated gases from the centre of the furnace to their delivery in the smoke chimney is 39 feet; from which will be perceived how short was the time the heated gases were in contact with the heat-absorbing surfaces. The proportion of the heating (copper) to grate surface was nearly 22 to 1, and seems to have been much too small for the proper reduction of the heat of the gases.

According to the experiments of Professor Walter R. Johnson, one pound of Cumberland bituminous coal requires for its complete combustion the oxygen of 237·31 cubic feet of air, at 60° F. temperature and 30° barometer. From the steam log of the *Powhatan*, it appears that the mean consumption of Cumberland coal for all the steaming done is 3808 pounds per hour, which would require 903,676·48 cubic feet of air, containing 180,735·296 cubic feet of oxygen, weighing 15,023·03 pounds; from this must be deducted the oxygen already in the coal, viz: 9½ per centum of 3808 pounds, or 361·76 pounds; leaving 14,661·27 pounds to be supplied from air. The combustible materials of the coal consist of carbon and hydrogen, in unequal parts, and these elements unite with oxygen in different proportions. The average composition of Cumberland coal may be taken as follows:

| | | |
|---|---|---|
| Carbon, | 75·0 | per centum. |
| Hydrogen, | 4·5 | " |
| Nitrogen, | 1·5 | " |
| Oxygen, | 9·5 | " |
| Earthy matter, | 9·5 | " |
| | 100·0 | " |

Of the above, the carbon and hydrogen only are combustible. As one pound of carbon unites with 2⅔ pounds of oxygen, and one pound of hydrogen with 8 pounds of oxygen, and as $75 \times 2\frac{2}{3} = 200$, and $4{\cdot}5 \times 8 = 36$, the total weight of oxygen (14,661·27 pounds) required for the combustion of the 3808 pounds of coal, would be disposed of in the proportion of 200 to the carbon and 36 to the hydrogen, or 12,022·24 pounds to the carbon, and 2639·03 pounds to the hydrogen. Now, 75 per centum of 3808 pounds is 2856 pounds, and 4½ per centum of 3808 pounds is 171·36; and 2856 pounds of carbon united with 12,022·24 pounds of oxygen = 14,878·24 pounds of carbonic acid gas, and 171·36 pounds of hydrogen united with 2639·03 pounds of oxygen = 2810·39 pounds of steam.

Of the total products of combustion of the 3808 pounds of coal, there would be—

| | | | |
|---|---|---|---|
| Uncombined Nitrogen from the air, | | 705,532·50 | cubic feet. |
| Nitrogen in coal, (1½ per centum,) | 57·12 pounds, or | 780·51 | " |
| Steam, | 2810·39 " | 76,177·20 | " |
| Carbonic Acid Gas, | 14,878·24 " | 129,664·53 | " |
| Total, | | 912,154·74 | " |

The uncombined nitrogen from the air will be the quantity of that element in the amount of air required for the combustion of the coal, less the quantity of nitrogen corresponding to the oxygen in the coal in the proper proportion for forming atmospheric air. Now, in the coal there was 361·76 pounds of oxygen, occupying in the gaseous state 4352·17 cubic feet; the quantity of nitrogen corresponding to this to form atmospheric air would be 17,408·68 cub. ft., which deducted from 722,941·184 cubic feet, (⅘ths of 903,676·48) leaves 705,532·50 cubic feet.

Thus the ultimate fact of which we were in search is, that for the complete combustion of 3808 pounds of Cumberland coal, there must pass per hour through the flues of the boiler 912,154·74 cubic feet of gaseous

matter at a temperature of 60° F. and barometer 30°. If we consider these gases to have entered the flues at a temperature of 1020 Fah., their bulk will have been increased three-fold, or will have become 2,736,464·22 cubic feet.

Now, the least cross area of the flues is 55,906 square feet, and at a velocity of 33·54 feet per second, or 120,744 feet per hour, there would be passed 4,049,753·76 cubic feet of gaseous matter, or 48 per centum more than required. Hence it appears that, so far from being any deficiency, there must have been a superabundance of oxygen supplied to the furnaces.

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## *The Magnetism of Torsion.**

We translate the following article from the French scientific journal *L'Institut*, of the 19th instant, on the subject of magnetic currents of induction produced by the torsion of iron. This was a communication from M. Mertheim to the Academy of Sciences at its last sitting, and details the results of his experiments, which will be found to have an important bearing on several mechanical questions:

It has long been known that a thread of iron, submitted to the action of terrestrial magnetism, becomes permanently magnetic when made to undergo a considerable amount of torsion equally permanent. An explanation of this circumstance has been attempted, in saying that the torsion acts in the same manner as every other mechanical disturbance, that it promotes the decomposition of the two magnetic fluids, and that at the same time it gives to the iron a certain coercive force. That opinion rests upon facts imperfectly observed. Torsion acts in a manner quite peculiar, in forcing the metallic molecules to arrange themselves spirally, and in thus giving to matter itself the form which Ampère has assigned to inferior currents. Torsion produces temporary magnetic effects when it is temporary, and permanent effects when it is permanent; and these effects cannot be produced by any other mode of action of mechanical forces.

*Temporary Effects.*—A bar of iron, magnetized to the point of saturation, becomes partially demagnetized at the moment it experiences a temporary torsion, and remagnetized at the moment of contrary torsion, (*detorsion*), or, in other words, it is traversed by an inverse current during the torsion and by a direct current during the contrary torsion, whatever may be the direction in which this torsion takes place.

We understand by "magnetization to saturation," the state of magnetic equilibrium in which a bar of iron is when it has received all the magnetic excitement it is susceptible of acquiring under the action of a given current, or which, after the interruption of that current, has already lost all which it was unable to keep. So long as that equilibrium is not established, torsion and contrary torsion only act as other mechanical disturbances.

The manner in which the experiment is made is as follows:—A bar of iron, well heated beforehand, 1 metre in length (nearly 40 inches), and 15 millimetres in diameter (nearly six-tenths of an inch), is rigidly fixed at

* From the London Mechanic's Magazine, December, 1852.

one of its ends, while the other is placed in the centre of a wheel, by means of which torsion in contrary senses can be produced upon it. It has two spirals, of which one is intended to receive the current of a single element of Daniell, while the other serves as a spiral induction. The latter is placed in communication with a galvanometer sensible to the astatic needle. It is unnecessary to observe that the two spirals are sufficiently remote from one another to prevent direct induction.

The establishment of the current causes the needle to move through an angle > (greater than) 90° towards the right. The north pole is found to fit into the spiral (*encastré*), and the south pole is twisted. When the current is made to pass in the contrary sense, the south pole of the bar fits in the spiral, the north pole is twisted, and the needle revolves towards the left.

The following table will exhibit at a glance the results of the experiment:

| Torsion to the Right. | Contrary Torsion. | Torsion to the Left. | Contrary Torsion. | Observations. |
|---|---|---|---|---|
| >90 right.<br>50 right. | >90 right.<br>45 right. | 90 right.<br>20 right. | 70 right.<br>35 right. | The bar beomes magnetized. Every other mechanical disturbance acts upon the needle in the same sense as torsion. |
| 3 left.<br>5 left.<br>20 left. | 50 right.<br>35 right.<br>30 right. | 12 left.<br>20 left.<br>20 left. | 45 right.<br>45 right.<br>30 right. | The bar being magnetized to saturation, the application of any force which does not produce torsion, leaves the needle at 0. |
| 70 left.<br>50 left.<br>12 right.<br>30 right. | 60 left.<br>50 left.<br>40 left.<br>42 left. | 90 left.<br>5 right.<br>14 right.<br>30 right. | 75 left.<br>50 left.<br>40 left.<br>40 left. | The current was reversed, and the result was that the same facts were reproduced, but in a contrary sense. |
| >90 right.<br>50 right.<br>20 right.<br>20 right. | 20 right.<br>0<br>5 left.<br>10 left. | 90 right.<br>35 right.<br>30 right.<br>12 right. | 10 right.<br>15 left.<br>15 left.<br>10 left. | The current was interrupted. The bar became demagnetized; itself at first at the point of saturation. |

The coercive force in every mass of iron may be measured by the number of torsions necessary to make it attain the point of saturation.

*Permanent Effects.*—When a bar of iron or a bundle of threads, has been magnetized by means of strong permanent torsion under the action, whether of the terrestrial current or of any other, it does not prevent the phenomena of an ordinary magnet. *All torsion—temporary or contrary torsion—which acts upon it in the direction of permanent torsion, produces magnetization, or a direct current; and all torsion, or contrary torsion, which acts in the opposite direction, produces demagnetization, or an inverse current.*

This experiment is easily performed with two bundles of the same iron thread, suspended vertically, and twisted so as to make of the one a helix *dextrorsum*, and of the other a helix *sinistrorsum*. They both have their north poles above, and their south poles below, and upon their being intro-

duced into the spiral, the needle is moved towards the right. But after having placed the north pole of each bundle in the spiral, if temporary torsions be given to the south pole, it will be found that a torsion in the same direction will produce contrary currents, according as it is applied to the one or to the other of the two bundles.

The following results are obtained:

| | Torsion to the Right. | Contrary Torsion. | Torsion. to the left. | Contrary Torsion. |
|---|---|---|---|---|
| For the *dextrorsum* bundle, which was first twisted from right to left. | 15 left. | 10 right. | 15 right. | 14 left. |
| For the *sinistrorsum* bundle. | 15 right. | 15 left. | 15 left. | 15 right. |

It is only necessary, therefore, to add to the apparatus a commutator, to reverse the direction of the current after each semi-oscillation, in order to obtain, by means of the turning vibrations, a continuous current which may be rendered highly intense.

These facts appear to me (M. Wertheim) likely to raise theoretical questions of extreme importance. I propose to discuss them in a work on the torsion of solid bodies in general, upon which I have been long occupied.

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For the Journal of the Franklin Institute.

## *Have we a New Power?*

The caloric ship Ericsson has since her trial early in January, made a trip to Washington for the purpose of demonstrating her success, and also of obtaining for Capt. Ericsson a contract from the government for one or more first class war vessels. Unfortunately for the community, (and also I think, for those who have invested their money in the enterprise,) no disinterested persons competent to judge were allowed on board, and to form an opinion from the reports of Capt. Ericsson or Capt. Sands, would be unfair; for the former is so deeply interested in the enterprise as almost to form a part of it, while the latter is unacquainted with machinery, and has given much of his testimony on hearsay evidence; there was no one on board to note the revolutions, weigh the coal, etc. The gentlemen interested in building this ship have been (it is understood) well pleased with the mystery that has been hanging around all their movements, and they are certainly entitled to the credit of having supported the enterprise with much cordiality, when even *they* were allowed to know but little of its details. I presume that a portion of this zeal may be attributed to the expectation on their part, of large profits; for the promise of a saving in fuel of 80 per cent. will convince many a man who will hold out against the prospect of fair returns. But to return to the ship. On a visit to Washington recently, I conversed with several engineers who visited her while she was at that port, and saw her engines in motion (the vessel being at anchor). The number of revolutions per minute was from 4 to 4½; the fires were burning bright, and in their

opinion, 6 to 8 tons would be the consumption per 24 hours; wheels, 29 feet diameter; paddle, only about 12 inches wide, and dipping under very slightly. Whatever may be the final termination, it is certain that up to the present time the results obtained have not equalled the expectations of the originators of the enterprise. The working pressure is but 8 lbs. instead of 12, and as a consequence, the paddle wheels have been reduced in diameter, and one half the paddles removed. While I really hope that the engine will succeed, and a new power more economical than steam be introduced to the world, I must say that the profound mystery that has been connected with the Ericsson goes far in my mind, to stamp the whole thing as a failure.

H.

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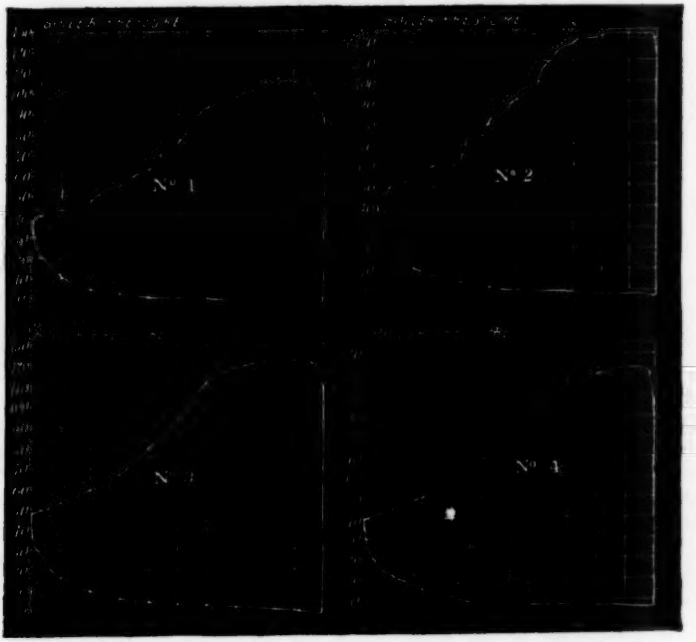
For the Journal of the Franklin Institute.

To the Committee of Publications:

GENTLEMEN:—The inclosed diagrams were taken from one of the engines of the steamer *George Collier*, a large first class cotton boat running between New Orleans and Memphis. I could not obtain the dimensions requisite for an analysis of her performance; she carries 850 tons of freight,




| INDICATOR DIAGRAMS. | No 1. | No 2. | No 3. | No 4. |
|---|---|---|---|---|
| Throttle open, . . . | ·25 inch. | 1·25 inch (full). | ·75 inch. | ·50 inch |
| Revolutions per minute, . | 12½ | 14 | | |
| Difference between boiler pressure and engine pressure, . | 26 | 2 lbs. | 8 lbs. | 12 lbs. |
| Mean pres. throughout the stroke, | 76 | 89·9 | | |
| Horses power, each engine, | 266 | 353 | | |

250 miles every 24 hours, with 50 cords of the ordinary river wood; her wheels are 34 ft. in diameter, with 11 ft. length of bucket; her valves are of the "balance poppet" kind, and cut off at $\frac{7}{20}$-ths from the commencement of the stroke; the diagrams taken with a "wide throttle" show that the openings are slightly cramped, and that the exhaust valves, or passages, are not large enough; her boilers, furnaces, and heaters are similar to the *Magnolia's*, but not constructed by the same engineer. The "balance poppet" valve was used on the Mississippi fifteen years ago, and found to be so troublesome to keep tight, with the excessive high pressures used, that it was abandoned; within the past four years it has been introduced again, but although with better success than formerly, it is superseded by the "double poppet;" and all the new boats of the larger class are supplied with engines fitted with the latter.

SAMUEL H. GILMAN.

*Baton Rouge, La., Feb. 24th*, 1853.

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For the Journal of the Franklin Institute.

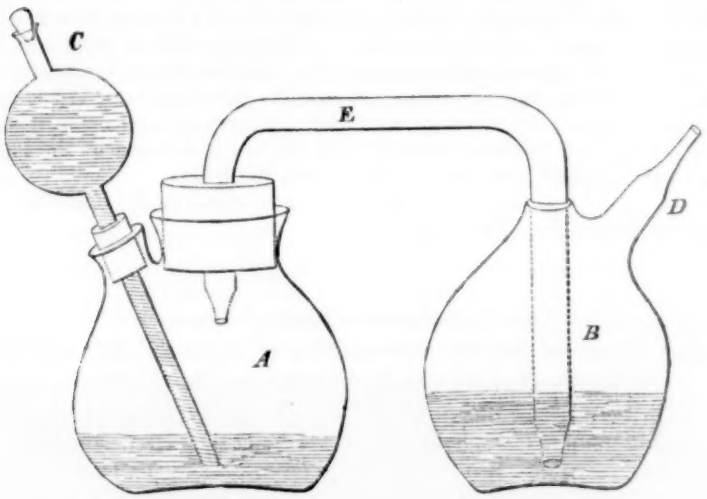
## *A New Apparatus for the Determination of Carbonic Acid with Fine Balances.* By CHARLES M. WETHERILL, Ph. D., M. D.

The apparatus of Fresenius and Will, for the determination of carbonic acid in certain carbonates, has so generally pleased chemists, that it has been almost universally adopted. As the results have been found by repeated experiment to be very accurate, it has been sought with various success, to modify the form, and to lessen the weight, in order to adapt it to the fine balances in ordinary use. A modification of this kind has been described by Max. Schaffner, in the *Chemical Gazette*, 1853, p. 37, which consists in placing the sulphuric acid in a large test tube, and the carbonate in a smaller one inside the former. In constructing one of these apparatus, I met with certain practical difficulties. The exterior test tube must be taken rather large; if the glass is thin, it risks breaking in fitting the cork; if the glass is thick, the apparatus is heavy. It is rather difficult to obtain a large cork, which will close sufficiently well. The interior test tube is so small, that but a small portion of the carbonate can be accommodated; and, if rich in carbonic acid, it requires a little care in bringing the acid upon it to avoid projecting a portion of the liquid from the tube. The perforation of the corks requires a little care in adjusting, so that the inner tube will readily enter. There are several joints where leakage may ensue, and the corks will have to be frequently removed. The large cork fitting the exterior tube, presents a large surface to hygroscopic action, and the apparatus, as described, will not suit such carbonates the gas of which requires to be set free by hydrochloric or nitric acid. I have no doubt that it would give accurate results in the hands of a skilful manipulator, and it might be improved, either by placing the acid in the small tube, or better by forming it of two separated test tubes smaller than the exterior one, and united as in Fresenius and Will's apparatus.

On the above mentioned grounds, I was led to endeavor to contrive one which would obviate the disadvantages attaching to similar apparatus,

and which, with equal accuracy and fewer joints, would be applicable to all purposes to which the Fresenius and Will apparatus is suited.

The apparatus described in this paper, has proved all that is desirable. It is represented in the drawing of the natural size. A, having been washed out and dried, by warming, and drawing air through by means of a tube




and cork inserted in the neck, is weighed, after having stood sufficiently long to become cool and to have attained the hygrometric state of its balance case. The carbonate is then added, and the weight a second time determined. After the addition of not too much water to A, the pipette, C, is adjusted, filled with nitric or hydrochloric acid in the case of insoluble sulphates, and empty in the contrary case, where it may be replaced by a simple tube. The pipette is filled by means of a tube and perforated cork, and closed by a wax stopper. After closing, it is warmed by the hand, so that a few drops of acid may escape, and that the acid may not, when cool, reach the extremity of the tube. This tube, if the bore is one millimetre in diameter, does not require to be drawn out at the extremity. B, is now adapted. The addition of water to the carbonate (in the case of dry alkaline carbonates) heats the flask, so that it must become cool before weighing, prior to the evolution of the gas. This is indicated by the rise of the acid in B, which acts as an air thermometer; by which means also the tightness of the joints is ascertained. When acid is used in C, care must be taken that some of it be not expelled by the alteration of temperature of A. When sulphuric acid is used to decompose the carbonate, the air is exhausted by suction at D, by means of a bent tube and perforated cork. The acid may thus be brought into A, and managed with the same control as in the apparatus of Fresenius and Will. The tube, E, is drawn out at both its extremities. It is filled with oil of vitriol by dipping in the acid, and exhausting at D by the bent tube and perforated cork. The last drop adhering to the extremity of E, must be

carefully removed before connecting the apparatus. This acid is saturated with carbonic acid, as will be shown subsequently. During the decomposition of the carbonate, the gas passes through the drop of acid at the end of E, left by forcing the oil of vitriol over, and passing through the tube, the sides of which are also moistened with oil of vitriol, becomes partially dried before reaching the flask B. At the end of the operation, air is drawn through the apparatus. The wax stopper is then fitted to the pipette, and the flask, A, held over a small flame until the contents are in a state of ebullition; the wax stopper is slightly removed, a little more air drawn through, and the apparatus, when perfectly cool, weighed. In analyses where it is necessary to effect the decomposition of the carbonate by acid in the pipette, C, the operation is carried on in an analogous manner.

This apparatus unites lightness with great strength, which is at once *felt* on handling it. This arises from the nature of the joint of E with B, and from the construction of the decomposition flask, which allows E to be made of a piece of stout tube. The one I first constructed and used for the following analyses, weighed when empty 36 grammes; and when charged for analysis, and with much sulphuric acid, together with the hook, between 50 and 60 grammes. It fits the hook which accompanies Oertling's balances for holding the chloride of calcium tube, &c., in organic analysis. An apparatus made of German glass, by Mr. Storm, professional glass blower, weighed when empty, with its corks, 20 grammes.

The Professors Rogers, by violent shaking for 20 minutes, in a peculiar apparatus, having caused sulphuric acid of common density to absorb 94 per cent. its volume of carbonic acid, have, rather hastily I think, rejected the apparatus of Fresenius and Will as liable to error. In one respect every mode of analysis is liable to error; the question should rather be, what accuracy is possible by careful manipulation? The Professors Rogers appear to have rejected this mode of carbonic acid determination, *a priori*, without having given it a fair trial. It has been in almost universal use for some time, and by careful analysts, without objection. Mr. Noad, who also employed it frequently, testifies (*Chemical Gazette*, 1848, p. 176,) to its accuracy, and communicates the results of some of his analyses. Carbonate of Soda yielded, 41·41 and 41·48 per cent. $CO_2$; theory requiring (Na = 23·178) 41·37. Carbonate of Potassa 31·81 and 31·84; theory 31·88. Carbonate of Strontia 29·75; theory 29·8.

In answer to Mr. Noad's communication (*Chemical Gazette*, 1848, p. 477,) the Professors Rogers give the results of two experiments, which they say will indicate the amount of error which *may* arise in the process of Fresenius and Will. They have calculated their loss in carbonate of soda equal to a per centage of 0·65 and 1·05. When their experiments are calculated for a loss of *carbonic acid*, 70 grs. gave a per centage loss of 0·27, and 60 grs. a loss of 0·43 carbonic acid, which is not so large that one might despair of lessening it by perhaps more careful manipulation, which the Professors Rogers admit might be done by drawing more air through the apparatus. But these I think are not perfectly fair experiments, since they do not take into consideration small constant errors on the other side, which would tend to more general accurate results; and also they should have been performed on perfectly *pure* and *dry* carbonate of soda, and the

results compared with each other and with the theoretical per centage of carbonic acid. Lastly, they did not consider that the sulphuric acid in Fresenius and Will's apparatus is under different circumstances from the acid in their experiments, and also that carbonic acid is readily expelled from liquids in which it is dissolved by a current of air.

Nevertheless, as in a small apparatus like the present, where the small amount of substance taken for analysis renders precautions necessary, which may be neglected in a large one; and also in order to lessen the quantity of air drawn through, I prefer saturating the acid in B with carbonic acid; which is readily effected by adding to dilute sulphuric acid in a test tube (which the cork of the apparatus fits) a couple of crystals of bicarbonate of potassa, and afterward drawing air through.

The following experiments performed with the apparatus, will show its accuracy. The sulphuric acid used was pure and of density 1·76.

About one gramme of perfectly pure carbonate of soda, (which was tested,) yielded in two experiments, a per centage of carbonic acid 41·42 and 41·35, which differ 0·07 per cent. from each other, and of which the mean 41·38 differs 0·01 from the theoretical per centage of carbonic acid 41·37, Na. taken at 23·178, as in Weber's tables.

In order to obviate the use of the tube C, and thereby simplify the apparatus by omitting the tubulus of A, I tried three experiments respectively upon 0·83, 0·859, and 1·0193 grammes of the same salt, which yielded a per centage of carbonic acid 40·93, 40·34, and 40·49. The liquid in the decomposition flask was boiled about as long as in the former series of experiments; but after detaching the apparatus, a more prolonged boiling evolved carbonic acid, which was shown by its precipitating lime water, the precipitate being soluble in hydrochloric acid. The presence of the tube, C, is therefore not to be avoided. The tubulus on A, (though most convenient) may be avoided by passing C through the large cork.

Carbonate of lime, (precipitated, commercial,) which contained sulphate and iron, gave the following results, the carbonic acid being evolved by nitric.

0·63025 and 0·61625 grammes gave a per centage of $CO_2 = 41·65$ and 41·70; difference, 0·05. The theory for *pure* carbonate of lime requires 43·88.

In order to ascertain the amount of error arising from evolving the $CO_2$ by sulphuric acid, two more experiments were made, which gave for result 38·79, and 39·17 carbonic acid.

Since for a second analysis with this apparatus, it is only necessary to detach the bulb B, (to which a little more oil of vitriol is added if requisite,) and wash and dry A, which is readily effected owing to its size, a series of analyses may be more quickly performed than by Fresenius and Will's larger apparatus, and its accuracy enables it to be employed on small quantities of substance. Its lightness suits it to all balances in general use. The joints are but few and the connexions readily made, while the cork surface is reduced to its lowest possible value. It may be applied to the analysis of manganese, and to all analyses for which Fresenius and Will's apparatus is suitable.

As it is possible that an objection may be raised to the flask B, I would state that it is of quite simple construction. The first one that I attempted,

with which the foregoing experiments were performed, succeeded, as did two others made subsequently.

The construction of the apparatus is effected in the following manner: A tube of sufficient size to form the bulb, B, is drawn out, true, and thin at both ends; one end is cut off close to the large part of the tube, which is then slightly flanched. The tube E is then taken of glass of sufficient substance, (of 4 or 5 millimetres exterior diameter and 1 mm. thickness of glass,) and by rotating it in the flame, heating a narrow zone, and pushing together, a thickened ridge, called technically a *marize*, is raised. The extremity which is to dip into the oil of vitriol, is now drawn out and cut off, and the marize is joined to the flanched opening, and well incorporated with it by careful melting. The tube D, the small end of which is closed, is now joined to the large one in the usual manner, inclining it slightly upwards, and the bulb is then blown. If the heating has been properly conducted, the apparatus will result pear-shaped, which is the most suitable form, and D will be inclined at the proper angle. Should D turn out in too horizontal a position, it may be raised by carefully heating its lower junction with the bulb, and bending it upwards, at the same time blowing. The bottom part of the bulb is now cut off, and flattened as in the figure. Lastly, the other extremity of E is drawn out, and E is bent at two right angles. The end of the tube D being cut off, the flask B is complete. It is necessary in drawing out the small end of D, to melt the glass well together, so that the extremity be of the required strength.

A is formed by commencing precisely as with B; but instead of cutting off and flanching one end, the tubulus is at once formed by joining a tube like D, and then blowing the bulb. It will be requisite to incline this tube which forms the tubulus, so that the pipette C will reach the surface of the water in the decomposition flask. The upper extremities of the tubes which form the neck, and the tubulus are now cut off and flanched. When cool, a straight open tube is adapted to the neck by the cork, and the bottom of the bulb cut off and flattened. The joint of the tube E, with the flask B, is very secure, if the glass has been well melted together, owing to the marize. I have heated this flask repeatedly, in drying it after washing it out, without cracking.

I am not aware that a tubulus is ever joined to a bulb *before blowing it*, as here described; and yet such a junction is very readily effected, by one but little skilled in glass blowing, and when well made gives a joint which is absolutely not to be distinguished from the substance of the flask. I have made small retorts with tubulus in this manner; and if it be not already known, I would strongly recommend it to (at least amateur) glass blowers, and especially to those who use lead glass. Messrs. Bullock & Crenshaw, at the corner of Arch and Sixth streets, have procured a supply of this apparatus, made according to my directions.

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## *New Art of Ornamenting Metallic Surfaces.**

Numerous as are the inventions or methods which have been applied for the ornamentation of metals within the last few years, we are not aware of any which, for simplicity and beauty, at all equal that recently

* From the London Mining Journal, No. 906.

invented and patented by Mr. R. F. Sturges, of Broad street, Birmingham. It affords the means of decorating plain surfaces of objects formed of metal at a reduction of cost which throws all other processes, devised or invented, into the shade, while at the same time it materially improves their appearance. The invention depends upon the compression of a material between two or more plates of metal in the operation of rolling. It may astonish our readers to learn that the most delicate thread lace, such as is used in ladies' attire, perforated paper, or wire webbing, when passed through a pair of rolls, leaves an impression upon the sheet of metal, corresponding in depth to the compressibility of the material used as the pattern, and the density of the metal upon which the pattern is required to be impressed or indented. Various articles in electro-plate, Britannia metal, &c., such as tea services, salvers, waiters, &c., demonstrate the value of the invention, and show that for all ordinary purposes it is equal to the much more expensive process of decoration by engraving. In the brass foundry trade, the proprietor of the patent, R. W. Winfield, Esq., of the Cambridge street works, intends to introduce the same for the ornamentation of his patent metallic bedstead pillars, curtain bands, &c. Several of the objects we have examined prove satisfactorily the applicability of this class of ornamentation for the purpose. Mr. Winfield, we understand, will supply the metal from his extensive rolling mills in the sheet, which manufacturers and others may convert into such objects as may be required to be made therefrom, and ornamented by the new process. The opportunity now afforded for the production of articles of elegant form and delicately ornamented surface, will no doubt be appreciated.—*Wolverhampton Herald.*

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### *Notice of the Explosions of Steam Boilers.**

A frightful accident occurred on the premises of the London and North Western Railway Company, at Longsight, near Manchester, on Tuesday morning, March 8th, whereby four men lost their lives, and at least a dozen received serious injuries. It seems that the engine No. 1, an old four-wheeled engine, made by Sharp, Roberts and Co., some fourteen years ago, and one of the first put upon the line, if not the very first, having undergone "a thorough repair," was in the Polygon shed, at Longsight, ready to start to act as pilot engine at the Standedge tunnel, on the Huddersfield and Manchester line. In a few moments more the driver would have taken the engine forward upon the turn-table in the centre of the building, in order that its head might be reversed, when suddenly the men in the Polygon were alarmed by a tremendous report and concussion of air. The place was immediately filled with steam and smoke, and a portion of the building came rattling down, overwhelming a very large number of them. As soon as the smoke and steam had cleared away, the persons uninjured found the tender standing where it had been before the occurrence, with the back wheels of the engine and the plate over them, on which the driver stands, still adhering to the tender; the engine itself was some thirty paces off, beneath the centre of the building, and it was from that the firebox had exploded. On looking for the persons injured, they discovered four men dead in the ash pit next to that upon which

* From the London Artizan, April, 1853.

the engine had been standing. Seven persons were got from beneath the *débris*, and, having been removed to the Manchester Royal Infirmary, one of them has since died. The cause of the explosion, as far as can at present be ascertained, is clearly over-pressure of steam. The engine, it seems, was worn out; some of the tubes at the side were quite filled up and useless, and some of the long stays were corroded very much; facts which seem to prove a want of supervision. The force of the concussion was so great, that it blew away every window in the shed, although the frames were cast iron; and it lifted up the floor of the reading room, and threw the men from their seats. Three cast-iron pillars, 27 feet long, and about 12½ inches in diameter, were thrown down with the roof. We have collected all the evidence upon the inquests that have been held; but, as other and more stringent investigations are in hand, we defer our remarks until their completion.

A locomotive boiler has exploded at the Brighton station. At about ten minutes to seven, the engine of the short train which leaves Brighton for Littlehampton daily at 7·15 was standing attached to its train, and ready for departure, when it exploded suddenly, and the various parts of the machinery were driven through the roof of the shed under which it was standing. The driver, the fireman, and a fitter, who were upon the engine at the time, were killed, and their bodies were found at some distance from the engine. Although some of the passengers were seated in the train, they all escaped without the slightest injury. From evidence already obtained, the directors have too much cause to believe that the accident arose from the driver having screwed down the safety valve shortly before the explosion took place. On the inquest, Mr. Chester Craven, locomotive superintendent, said, in answer to the coroner, that he had foremen in different departments to inspect everything; he himself interfered only when his attention was called to serious defects. The exploded engine was built by Messrs. Rennie in 1840, but had been patched and patched, till it had been nearly rebuilt. On the 4th of March, it was inspected by Ardron, inspector of working engines, and pronounced perfect. It had run 95,000 miles; but they expected 300,000 miles from an engine before parting with it. In 1840 boilers were made with 5-16ths plates, but now with 7-16ths. They did not put new boilers into engines. When a boiler had worn out two new boxes and two new sets of tubes, the engine was given up. He believed that this accident arose from over-pressure, arising from the safety valve being unduly pressed down.

A fatal steamboat explosion occurred on board the *Engineer* steamboat, off Tyne bar, on Thursday, the 10th March. One of the joiners, who was scalded, is dead, and a baker, of the name of Elliott, is in a very dangerous condition. The other seven persons scalded, though suffering much from the wounds they sustained, are recovering. It seems the *Engineer* was a new vessel, and was making her trial trip. She left Mr. Almond's works about five o'clock in the afternoon, with about twenty persons aboard, and had crossed the bar, and got about a mile and a half to sea, when the explosion took place. In a moment, and without any previous warning, what is called the "tubing" of the starboard boiler gave way with a terrible noise, the steam and water washing the coals from the coal-hole into the fore cabin, and bursting open a portion of the deck, some of the planks of which were blown into the sea. The boiler has

since been carefully examined, to ascertain the cause of the explosion, and a wooden plug has been found in the boiler that exploded. The presence of the plug, and the origin of the explosion, are accounted for in this way:—The boat has two boilers, one on the starboard, and one on the larboard side. They are connected together by a pipe which feeds the engine and communicates with the safety-valve. The pipe is screwed on to the boilers at each end, and, to prevent the escape of steam, is also cemented at the ends. Before screwing the pipe to the boiler, a wooden plug is driven in, to keep it steady, but which is taken out after the screws are fastened. The plug fastening the piping to the starboard boiler, there is every reason to believe, had been forgotten by the workmen, and left in, and, effectually preventing the steam from escaping, had occasioned the explosion.

## AMERICAN PATENTS.

*List of American Patents which issued from March 8th to April 5th*, 1853, (*inclusive,*) *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

MARCH 8.

9. For an *Improvement in Printing Presses;* Seth Adams, Boston, Massachusetts.

*Claim.*—"Having described my improvements in printing presses, what I claim as my invention is, 1st, The combination of said vibrating platen with the sheet holders, arranged as herein above specified, so as to be kept up a little distance from the platen, when in position to receive the sheet, and moving with said platen to the form, in order to hold the sheets thereon, and draw them from the type, also with the gauges for separating the sheets. 2d, I also claim the mode or means herein above described, for keeping the sheet holders up from the platen, when the sheet is to be placed; said means consisting of an arm on each end of the rod, (on which said holders are fixed, and with which they turn,) and stops, against which said arms strike; the arrangement and operation being substantially as herein above set forth. 3d, I also claim the apparatus for delivering or taking off the sheets from the platen, after it is printed, consisting of the moving or sliding tympan cloth, in combination with the turning segment, to which an intermittent and reciprocating rotary motion is imparted by the catch, ratchet, and spiral spring, operating as above specified."

10. For an *Improvement in Cane Juice Evaporators;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

*Claim.*—"Having described the nature of my invention, and the manner of constructing the same, what I claim is, the combination of a hollow and perforated shaft, connected with an air blast apparatus, a series of plates, or a screw plate, placed around and on the shaft, and a reservoir trough or basin, for holding the liquor to be evaporated, all substantially as above specified. 2d, And I also claim the combination of a hot water vessel and its heating apparatus, the cistern for holding the saccharine liquor, and the apparatus for effecting its evaporation, by means of hot air blown on thin or extended surfaces, a screw or plates, as specified."

11. For an *Improvement in Filters for Cane Juice;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

*Claim.*—"Having described my invention, what I claim is, the combination of the receiving vessel, the rotating filtering drum placed within the said vessel, the gutters within the drum, the hollow axle or shaft connected with said gutters, and the scraper applied to the outer surface of the revolving drum; the whole being arranged and made to operate together, substantially in manner and for the purpose as herein before specified."

12. For an *Improvement in Machines for Breaking and Dressing Flax;* Stillman A. Clemens, Springfield, Massachusetts.

*Claim.*—"What I claim as my invention is, the method of breaking and dressing flax or other fibrous substances, by a beater constructed in the manner described, (vibrating on a central axis,) between the faces of which the flax, &c., passes as described, when this is

combined with one or two pairs of rests placed in close proximity to the edges of the beaters, between which the flax passes, substantially as described. And I also claim, in combination with the beater and rest for breaking and dressing as described, the employment of a pair of rollers, each of which is grooved in the direction of its periphery, and one of which is made to vibrate in the direction of its axis, for the purpose of opening and softening the fibres, substantially as herein described."

13. For an *Improved Magnetic Machine for Washing and Separating Gold;* Samuel Gardiner, Jr., City of New York.

*Claim.*—"I do not claim to have invented a rotary cylinder of magnets, for the purpose of separating magnetic particles from ores or metals; but what I claim as my invention is, separating gold or other metals from earthy or other magnetic particles, by means of a rotary cylinder of magnets, which magnets, at the same time that they collect the magnetic particles, serve as agitators for agitating the water and the metal, and earthy and other foreign matter with which it is mixed, for the purpose of washing away the said earthy and other foreign matter; the said cylinder of magnets being constructed and arranged, in relation to the trough containing the aforesaid mixture, in any way substantially as herein set forth."

14. For an *Improvement in Daguerreotype Plates;* J. F. Mascher, Philadelphia, Pa.

*Claim.*—"I do not claim the invention of the stereoscope, for that has been previously discovered; but what I claim as new is, constructing a daguerreotype case with an adjustable flap or supplementary lid, said flap or lid being within the case, and having two ordinary lenses placed in it, by which, by adjusting the flap or lid as shown, a stereoscope is formed of the case, and the two daguerreotypes, by binocular vision, are apparently formed into a life-like figure."

15. For an *Improvement in Machines for Moulding in Flasks;* Lysander A. Orcutt, Albany, New York.

*Claim.*—"Having fully described the nature of my invention, what I claim therein as new is, in combination with a flask having a continuous or reciprocating rotary motion, the rammer or rammers, so arranged as to be made at any time during their operation to work in any portion of the flask, whilst at the same time they have an automically adjustment, so as to rise as the flask is filled and rammed, and adjust themselves vertically in regard to the flask; the whole being accomplished substantially in the manner described."

16. For *Improvements in Moulding for Cast Iron Plates with Dovetailed Recesses;* Thaddeus A. Smith, Albany, New York.

*Claim.*—"I claim the process of moulding the recesses in the tops of stove plates, intended for the reception of the lifters by which such plates are handled, (which recesses are required to be dovetailed,) by employing pattern cups shaped to form such recesses, divided by a vertical cut into two parts, so that the said cups can be removed from the core formed by them, by moving each division of it horizontally from the core before raising it off the sand, and by fitting the cup pattern into the pattern of the stove plate, so that the plate pattern can be lifted from the sand, leaving the cup behind it, substantially as the same is set forth in the above specification."

17. For an *Improvement in Machines for Dressing Shingles;* Joel Tiffany, Cleveland, O.

*Claim.*—"What I claim as my improvement is, the combination of parts consisting of the pinions, with the intermediate gears, the levers, and joint levers, and sections, with the connecting rods and cam, for the purpose of operating the arms, as described, viz: turning and removing shingles at the same time, from one side of a reciprocating bed to the other, and then when its second face is dressed, throwing it from the machine in a finished state."

18. For an *Improved Cannon Sight;* John J. Wagener, Charleston, South Carolina.

"The nature of my invention consists of an easy and correct mode of determining the highest point of the surface of a cannon, regardless of any position which the wheels on account of any uneven surface may occupy, and of affording the gunner at the same time, a perfect sight to direct and elevate the piece by, capable of regulation for any distance less than point blank, as well as to extreme range, according to degrees."

*Claim.*—"What I claim as my invention is, the sighting apparatus, consisting of the corresponding pendulum, as described, hung between the graduated side pieces, or uprights, in connexion with the protecting and regulating slide, with its rifle sights; said pendula having free sway, by means of the rotary mounting of the uprights and upper

part of the apparatus on the screws and pivots, and the whole being attached and shifted into horizontal position on the cannon, by means of the movable spring clasps, all constructed and combined substantially as set forth."

MARCH 15.

19. For an *Improvement in Turning Lathes;* Warren Aldrich, Lowell, Massachusetts.

*Claim.*—"Having described my improvements in turning lathes, what I claim as my invention is, 1st, the improvement herein above described, which consists in giving an automatic motion to the upper slide or tool rest, when set at any angle to the bed piece of the lathe, instead of moving it by hand, so as to turn with ease and accuracy, solid or hollow cones, as above set forth, by means substantially of the screw, revolving worm shaft, and revolving plate, as above set forth."

20. For an *Improvement in Machines for Expressing Sugar Cane Juice;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1853.

*Claim.*—"Having described my invention, what I claim is, the improvement of constructing each of the cane pressing tubes, substantially as specified, viz: with sides made parallel some distance, (for the working of the piston against,) and to approach one another towards the mouth of discharge of the pressed cane, whereby advantages as above mentioned are obtained. I also claim the combination and arrangement of two compresses, or pressing tubes, and two conjoined pistons, with one revolving actuating shaft, and its mechanism, to give to their plungers or pistons a simultaneous reciprocating rectilinear motion, all as represented."

21. For an *Improvement in Heaters for Sugar Syrup;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

"I am aware that in locomotive engines, water has been heated by standing in tubes exposed to the flame or direct heat of a furnace; now such a mode of heating will not answer for the treatment of the saccharine syrup, as the heat of a furnace is not susceptible of regulation as is that from steam, the latter not burning the syrup or injuriously heating it, as would the former. I have discovered that the heat of steam applied to syrups in manner described, in connexion with the action of gravity, produces advantages in rapidly heating the syrup, unattainable by any process where the syrup is passed through pipes, heated by direct heat or the flame of a furnace. It is, therefore, that I expressly disclaim the mode of heating water by allowing it to flow through, or stand in tubes heated by the direct heat of a furnace, but base my invention on the above described method of treating saccharine syrup by means of the apparatus represented, as there arranged and constructed, to operate for the purpose set forth, by the power of gravity and steam; the same consisting of a combination of the receiving vessel, the series of tubes, the chamber and its pipe, and the steam chamber, having induction and eduction pipes, as specified."

22. For *Improvements in Supporting the Topping Lift and Peak Halyard Block of Sail Vessels;* William and S. G. Coleman, Providence, Rhode Island.

*Claim.*—"What we claim as our invention is, the supporting the topping lift by means of a crane of such form and construction, that when the topping lift sags when the sail is hoisted, it shall not foul or chafe against the peak halyard block. We also claim the so arranging and constructing such crane that it may also support the peak halyard block, substantially as specified."

23. For an *Improvement in Rocking Chairs;* Peter Ten Eyck, City of New York.

"The nature of my invention consists in combining with a chair, so arranged as that the top of the seat shall rock upon the bottom part, whilst the legs remain stationary, a safety guard, to prevent the chair from going back too far, and also to prevent it from going suddenly backward, when the person seats himself in it."

*Claim.*—"Having fully described the nature of my invention, what I claim therein as new is, in combination with a sitting chair, so arranged as that the seat may rock upon the legs or support, the safety piece or guard, hung eccentrically to the pivot of the bar on which it rests, and the spring for preventing the top part of the chair from rocking too far or too suddenly, substantially as herein described."

24. For an *Improvement in Knitting Machines;* Moses Marshall, Assignor to M. Marshall, W. Aldrich, and L. B. Tyng, Lowell, Massachusetts.

*Claim.*—"Having described my improvements in knitting looms, what I claim as my

invention is, 1st, Constructing the rotary depresser and the feeder which carries the thread, with the arm which connects the reciprocating cam bores, substantially as above described. 2d, Dividing the plates which support the needles and cast the stitches at the angle of intersection of the two sets of needles, so that the fabric knit will or may pass between them. 3d. I claim forming the stitches alternately on each side of the needle rests, by two sets of needles placed at an angle to each other, and operating one needle at a time, substantially as above set forth."

MARCH 22.

25. For an *Improvement in Hydraulic Steam Pumps;* Horatio N. Black, Philadelphia, Pennsylvania.

*Claim.*—"I do not claim a double cylinder pump or water engine; nor do I claim opening a valve at the end of the stroke of a steam piston, and injecting water into a steam cylinder, for producing a partial vacuum; but what I claim as my invention is, the combination of the double slotted water and steam cylinder, double pistons, and slotted piston rod, arranged and operating in the manner and for the purpose set forth in the foregoing specification."

26. For an *Improvement in Separating Paper by Single Sheets;* John P. Comly, Dayton, Ohio.

"My invention consists in a method of feeding or supplying paper, sheet by sheet, from a heap, through the agency of atmospheric pressure, and having reference especially to the instances in which the sheet has to be raised and drawn forward by one edge, as in the case of printing, and is intended to supersede the services of the attendant now found necessary to feed the machine."

*Claim.*—"What I claim herein as new is, 1st, A table or range of tubes, connecting with an exhaust pump or vacuum, for separating the edge of a sheet from a heap of paper by atmospheric pressure, in combination with a roller or its equivalent, traversing to and fro on the upper sheet, for the several purposes of lowering and admitting air between the leaves, presenting the edge of the top sheet to the tubes, and (on its backward stroke) serving to straighten the pile. 2d, The tube or tubes aforesaid, in combination with the vibrating supporting bar, for upholding the forward edge of the sheet, when dropped by the tubes, presenting it properly to the fingers, and supporting it from the heap, while being drawn away."

27. For an *Improvement in Tanning;* Roswell Enos and Bela T. Hunt, St. Charles, Illinois.

*Claim.*—"What we claim is, the process of tanning, with the use of lime, salt, bran, sumac, and cutch, or any other tanning in room of cutch, substantially in the manner above described, whereby we commence tanning at the same time that we commence reducing; as the salt and bran overpowers the lime, the tan takes the place of the lime and converts the hide into more perfect leather, and in less time than can be made in any other way. Hides are not liable to get damaged by our process, as we do not use an article that is injurious to leather. It is not on the materials used that we claim letters patent, but on the manner of applying them to the hide, as set forth in the schedule."

28. For an *Improvement in Cheese Presses;* Mills A. Hackley, Belleville, New York.

*Claim.*—"What I claim as my invention is, the turning table, or its equivalent, in combination with the roller, in such manner that whenever the table is adjusted for turning the cheese, there will be a corresponding adjustment of the roller, for facilitating the process of turning the same."

29. For an *Improvement in Knitting Machines;* Wm. Mansfield, Dracut, Mass.

*Claim.*—"What therefore I claim as my invention is, the above described improvement in forming the loops in knitting ribbed fabrics, viz: by the combination of two sets of needles made to operate together, substantially as herein before set forth; the same enabling me to gain important advantages in the construction and operation of the loom."

30. For an *Improvement in Processes for Distilling Rosin Oil;* James Riley and Wm. Allen, Southfield, New York.

*Claim.*—"Having fully described the nature of our invention or discovery, and shown one of the methods of reducing it to practice, what we claim therein as new is, the process by which we manufacture oil from rosin, by passing it from an alembick through expanding

worms, or their equivalents, surrounded by a jacket of fire-brick or clay, whereby we prevent destruction, distillation, carbonization, and greatly economize time, substantially as set forth."

31. For an *Improvement in Harness;* James Stanbrough, Newark, New York.

*Claim.*—"What I claim is, the forming of rounds, raises, or rolls, on the different parts of a harness or other leather work, by doubling and stitching together a strap of leather at its edges, and then binding these edges by a separate piece, and connecting the stitching of such binding, by drawing up and fastening by the side thereof, folds of the strap; and this I claim, whether the single strap only be used for forming a single roll, or a secondary strap be used for forming two or more rolls, substantially as described."

32. For an *Improvement in Machines for Pegging Boots and Shoes;* Seth D. Tripp, Rochester, Assignor to Edward L. Norfolk, Salem, Massachusetts.

*Claim.*—"What I claim as my invention is, the combination of each frame with its supporting shaft by means of a rocker frame; the same being for the purpose of allowing a free vertical as well as other movements, as above described, of either of the frames, so that it may be guided in its vertical movement by the curvature of the upper surface of the sole of the boot or shoe, and horizontally by the cam wheel, substantially as above specified. I also claim the manner of combining the awl and driver with one carrier, made to operate substantially as above described, whereby they are alternately presented or brought down against or towards the sole by the revolution of the carrier, substantially in the manner as above specified. And I also claim the combination of the guide with the knife or chisel, and so as to operate therewith substantially as specified, in the manner and for the purpose of guiding said chisel properly against the peg wood, as described. I also claim the improvement in the construction of the charger, viz; the making of the same with two or more separate compartments, for holding the strips of peg wood, which compartments are to be successively brought forward, under the operation of the piston slide, as the several pieces or slips of peg wood are successively cut up into pegs, meaning to claim a combination of a series of compartments, with one single piston slide, made to operate substantially as above set forth. I also claim the combination of mechanism by which the charger is moved; the same consisting in the operating spring, the rack, the click or pawl, and the spring, applied to the upright part of the pawl, the whole to act in conjunction with the piston slide as above described. I also claim the combination of mechanism for operating the slide, the same consisting of the rack or ratchet thereof, the impelling pawl, the spring lever, the cam, the ratchet wheel, and the spring hook pawl, as applied to the frame and the bar and made to operate, substantially as above set forth; the same causing peg wood to be shoved through the charger, and keeping the pegs in advance of the peg wood, and successively forcing them into the correct position, over the hole made in the sole by the awl. And, in combination with the pressure spring, I claim the lever with its bent projection, spring, bent lever, and cam; the same being for the purpose as above set forth."

## MARCH 29.

33. For an *Improvement in Preparing Lubricating Oils;* Luther Atwood, Boston, Massachusetts.

*Claim.*—"What I claim as my invention is, the coup oil, or new manufacture, (or combination of paranapthaline and fixed oils derived from coal tar, and boiling from four hundred and fifty degrees to six hundred and seventy-five degrees Fahrenheit,) as produced by the process substantially as herein before described; the said new manufacture being highly useful as a lubricating composition, either alone or combined with oils or fatty matters, as above set forth. I also claim the combination of this product, so made with concrete or thick fatty matters, or oils, for the purpose of liquifying them or rendering them more mobile, or imparting to them lubricating qualities, as herein before specified."

34. For an *Improvement in Winnowers of Grain;* Schuyler Briggs and John G. Talbot, Sloansville, New York.

*Claim.*—"What we claim as new is, causing the upper sieve or riddle to vibrate at a greater speed than the screws, in the manner and for the purpose herein set forth."

35. For an *Improvement in Machines for Breaking Hemp;* Lewis W. Colver, Louisville, Kentucky.

*Claim.*—"Having fully described my invention, what I claim therein as new is, the combination of the oscillating beaters and the spring bars, placed above and below said

beaters, so that the recoil of the springs, after the beater leaves the bars, shall shake out the hemp and clear it of its woody portions, substantially as described."

36. For an *Improvement in Hot Air Furnaces;* Wm. Ennis, City of New York.

*Claim.*—"What I claim as my invention is, 1st, the employment of an inverted cone within a drum or cylinder, in whose side the taper end of said cone is inserted, and allowed to communicate with the "atmospheric reversing draft," to cool the direct heated current from the fire; the said cylinder communicating with the fire chamber and ash pit, in the manner and for the purpose substantially as herein described."

37. For an *Improvement in Electric Telegraphs;* Moses G. Farmer, Salem, Mass.

"The object of my invention is, to enable a common telegraphic circuit, extending between any two places, to be used by two or more operators at the same time, instead of but one operator, as it is at present; or in other words, suppose that we are to have four operators stationed at one end of the line, and each conducting or operating a single key or instrument for breaking and closing the circuit; also, that we wish to communicate with four persons at the other end of the line, by means of four signal instruments there placed."

*Claim.*—"What I claim as my invention is, the method herein above described, of bringing any number of telegraphic signalizing and recording instruments into successive electric connexion with the common communicating wire; meaning, more particularly, to claim the combination of the writing and working, or primary and secondary circuits, the electro-magnets and movable armatures of the primary circuit, the local magnets and their movable armature and pallets, or equivalents therefor, and local battery and battery connexions of each terminus, and connexions leading to the armatures of the local magnet, the escapement wheels, and wheels on the arbor of each, the two series of springs of said wheels and branch connexions, and the branch connexions of the main writing circuit at its two termini; the whole being connected and made to operate together substantially as described."

38. For an *Improved Pendulum Balance for Quick Weighing;* Benjamin Fenn, Hartford, Ohio.

*Claim.*—"What I claim as my invention is, a machine for ascertaining, instantly, the weight of bodies, by means of a scale, dish, or plate, supported by pivots upon a heavy or weighted semi-circular frame, or its equivalent, in the manner of a pendulum, and operated upon by catches, substantially as herein described."

39. For an *Improvement in Seed Planters;* Isaac H. Garretson, Clay, Iowa.

*Claim.*—"What I claim is, planting corn in check rows, by the planting sides worked on the cross bar by hand, in the manner set forth."

40. For an *Improvement in Knitting Machines;* John Maxwell, Galesville, New York.

*Claim.*—"I claim the construction of the locking apparatus, by placing standards upon the back ends of the half-jacks to carry springs, which regulate the pressure of the bar upon the jacks, in combination with an apparatus for raising said locking bar; the whole constructed in the manner substantially as set forth in the within specification."

41. For an *Improvement in Paging Bound Books;* John McAdams, Boston, Massachusetts; ante-dated September 29, 1852.

*Claim.*—"Now, I do not claim the use of type chains for paging books, as they have already been secured to me by letters patent granted August 12th, 1852; but what I do claim as new is, the employment of the square rotating shaft, *d*, as a bed for the odd numbers, and the shaft, $d^1$, as a bed for the even numbers of the types, in combination with the tongue, as a platen to both sets of types, the same being operated by the treadle, ratchets, and pawls, so as to enable the operator to print the odd and even numbers of the alternate pages of a bound book, by the single movement of the treadle as above described."

42. For an *Improved Arrangement of Die Rollers in Spike Machines;* James H. Swett, Boston, Massachusetts.

*Claim.*—"Having fully described the nature of my invention, what I claim therein as new is, skewing the shafts or axes of rotary printing dies, so that they shall stand oblique to each other, and beveling off the faces of the dies to the same, or about the same angle at which the shafts stand to or cross each other, for the purpose of forming a close fitting space in front of the dies, or where the blank is fed in, and spreading the dies in rear, or

behind, where the spike is pointy, so as to release it and allow the nippers to take the spike from the pointing dies without injury to the spike, substantially as described."

43. For an *Improvement in Vertical Pianos;* George Traeyser, Cincinnati, Ohio.

*Claim.*—"I claim as new, the construction as described, of a vertical piano, having the tuning pins placed below the lower edge of the sounding board, for the objects herein explained."

44. For an *Improvement in Sewing Machines;* Thomas C. Thompson, Ithaca, N. York.

"The nature of my invention consists, first, in charging the race or shuttle with magnetism, for the purpose of keeping the shuttle in perfect contact with the face of the race, without the use of springs or holders of any kind, whilst, at the same time, I insure the taking up of every stitch; also, in making the shuttle with a hinged cap, for the more readily placing therein and retaining of the bobbin or cop, which is used without a spindle or spooler; the thread being drawn from the inside of the cop or bobbin, by which means an uniform strain or tension is preserved on the bobbin or cop thread."

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, 1st, the magnetic shuttle and race, one or both, for the purpose of keeping the shuttle in perfect contact with the face of the shuttle race, without the use of springs or any other device, and thereby insuring the securing of every stitch, substantially as described. I also claim the curved and hinged cap, in combination with the shuttle, to confine the cop in the shuttle, substantially and for the purpose set forth. I also claim the use of a cop without a spindle or spooler, in combination with a shuttle, or its equivalent, when the thread is drawn from the inside of the cop, by which means I retain an uniform draft on the cop thread as it is drawn or paid out from the shuttle, substantially as described."

45. For an *Improvement in Wire Fences;* Matthew Walker, Matthew Walker, Jr., and Daniel S. Walker, Philadelphia, Pennsylvania.

*Claim.*—"What we claim as our invention is, first, the arrangement of the hooks within the mortises, so that the parts of the hook shall be sustained and kept from spreading by the mortises, and a strain upon the wires tend to steady the posts, as described."

### Re-issues for March, 1853.

1. For an *Improvement in the Mode of Operating Brakes for Cars;* Nehemiah Hodge, North Adams, Massachusetts; patented October 2, 1849; re-issued March 1, 1853.

"My invention consists in a combination of mechanism, which, when applied to or connected with the brakes of two trucks or truck frames of a railway car, and two windlasses, respectively situated at the two ends of the floor frame of a car, shall, when either windlass is put in rotation so as to wind up its chain, bring down at the same time, the brakes of both truck frames upon the wheels thereof with the same degree of force, and whether when the car is running on the railway, the axles of the wheels of one truck are thrown or moved out of parallelism with those of the other truck, or the rubbers or brakes become unequally worn, or are of an unequal thickness."

*Claim.*—"I am aware that the brakes of a car made with trucks or truck frames have, before the date of my invention, been connected in different ways, so that the brakes of both trucks could be brought down simultaneously upon the wheels, by the action of either windlass. I therefore do not claim any machinery for doing merely this, but when this has been done, the machinery applied to the windlasses and brakes of the trucks has not been such as to cause, under all, or nearly all circumstances, while the car is in operation, or running on a railway track in which there may be curves or deflexions from straight lines in the laying of its rails, and when either windlass is put in operation, the like amount of force which may be brought to act upon the brake lever of one truck, to act through the movable rod or connecting mechanism upon the brakes of the opposite truck. I therefore claim my improvement in actuating the brakes of a car having two trucks; that is to say, I claim a combination of two levers, $f$, $f^1$, a rod, $h$, two levers, $c$, $c^1$, and rods, $d$, $d^1$, as applied to the brakes and two windlasses of the car, and operated by either of the windlasses, so as to bring down at the same time, the brakes of both trucks upon the wheels thereof, with the same, or practically the same degree of force, and whether when the car is running on the railway, the axles of one truck, or of the wheels of one truck, are thrown or moved out of parallelism with those of the other truck, or rubbers, or brakes, become unequally worn, or of an unequal thickness, as above stated."

2. For an *Improvement in Splints for Fractures;* Adam Hays, Pittsburg, Pennsylvania; patented August 13, 1850; re-issued March 8, 1853.

*Claim.*—"What I claim as my invention is, the cutting out a portion of the splint, to afford an opportunity for dressing as often as may be necessary, the upper and lower portions of the splint being kept firmly united by means of the brace, so as by extension of the parts concerned; the slide being replaced after each dressing, or any other device substantially the same."

3. For an *Improvement in Self-Acting Mules for Spinning;* Wanton Rouse, Taunton, Massachusetts; patented November 2, 1852; re-issued March 15, 1853.

*Claim.*—"What I claim as my invention is, 1st, Governing the revolution of the spindles in winding the yarn on the cop, and also in backing off during the progressive stages of the building, by means of a cam, or any equivalent device of irregular form, circumferentially, with the said irregularity, varying from end to end; the said cam or equivalent being caused to operate upon the mechanism which drives the spindles, in any way that will produce the results herein set forth. 2d, The mechanism for causing the finger through which the irregular surface of the cam, or its equivalent, acts upon the mechanism which drives the spindles in backing off and building on, to traverse the said cam, and to be kept close to its surface, consisting of the screws, *e* and *k*, the nut, *j*, cord or chain, *f*, lever, *o*, and stud, *h*, operating in combination, in the manner substantially as set forth."

4. For a *Machine for Arranging and Feeding Screw Blanks;* Thomas J. Sloan, City of New York; patented February 25, 1851; re-issued March 29, 1853.

*Claim.*—"What I claim as my invention are, the lifters, which select and lift the blanks, etc., from the hopper, substantially as specified, in combination with ways or conductors, or the equivalents thereof, substantially as specified, into, or on to which the blanks, etc., are transferred as specified. And I also claim giving to the lifters, or to the inclined ways or their equivalents, a lateral motion, in combination with a stop or detector, substantially as specified, for the purpose of arresting the operation of the lifters, until a farther supply is required, as specified. And finally, I claim the sliding carrier with its recess for receiving and holding the screw blanks, substantially as specified, in combination with the spring fingers, substantially as specified, for taking the screw blanks from the carrier, and presenting them to the jaws, as specified."

APRIL 5.

1. For *Improvements in Process for Forming Yarn by Felting;* John H. Bloodgood, New Jersey.

"The nature of my invention consists in the production of a strong felted roving or untwisted thread of wool, capable of being employed for warp or weft, in making woven cloth, or for knitting, sewing, and other purposes."

*Claim.*—"What I claim as my invention is, the formation of thread or yarn from woolen rovings, by the process of felting instead of twisting or spinning, substantially as herein set forth."

2. For an *Improvement in Grain Harvesters;* Thomas D. Burrall, Geneva, New York.

*Claim.*—"In the machine above described I claim, 1st, the additional apron to convert the usual rear discharge into a side discharge of the cut grain, constructed and arranged substantially in the manner set forth. 2d, I claim the combination of the curved supports and the adjustable journal box piece, to preserve the relative positions of the cogs in the mitre gearing, and at the same time allow of raising and depressing the driving wheel; the gearing, &c., being constructed and arranged as described and represented."

3. For an *Improvement in Ploughs;* Solomon Horney, Jr., Richmond, Indiana.

*Claim.*—"Having thus fully described my invention, what I claim as new is, constructing the shank hollow, in a single piece with two closed ends, substantially as described, and securing the same to and with the share and beam, by means of master bolts and the short bolt, for passing through the slot in the top end of the hollow shank, for varying the position of the shank with the beam, and for giving additional security to the fastening of the same, substantially as herein set forth."

4. For an *Improvement in Water Metres;* Wm. H. Lindsay, City of New York.

*Claim.*—"I do not claim operating the valves of the main engine or cylinders by means of a secondary or independent engine, the valves of which are actuated through the me-

dium of the primary engine, the same being well known in the construction and operation of hydraulic engines, &c.; but what I do claim as my invention is, 1st, operating in the manner and for the purpose herein described, the valves of a secondary engine, by the main engine, through a portion of their movement, and completing the same through the medium of the secondary engine. 2d, Connecting the cross head of the main cylinder, in case the working parts of the secondary engine should fail to do their duty. 3d, I do not claim the balancing of slide valves, as such has heretofore been done in various ways; but what I do claim is, forming a recess or recesses, in the under or working side of the slide valve, in combination with the secondary opening or openings through the seat, or in the side of the port or ports, for the purpose and in the manner substantially as herein described. 4th, I do not claim making a connexion between opposite sides of the plunger piston, at a certain portion of its travel, as that has heretofore been done; but what I do claim is, the combination of the bridge in the cylinder, in combination with the openings in the plunger, for the purpose and in the manner substantially as herein described."

5. For an *Improved Apparatus for Feeding Blanks to Screw Machines;* Thompson Newbury, Taunton, Massachusetts.

*Claim.*—"What I claim therein as new is, the slide, substantially as herein described, passing up through the bottom of the hopper in the manner set forth."

6. For an *Improved Arrangement of Sash Fasteners;* Henry R. Noll, Lewisburgh, Pa.

"My invention and improvements consist in so arranging the spring catch fastenings for window sashes, that the spring for the upper sash may be commanded without interference with the lower sash; that is to say, if the lower sash is raised, the spring of the upper sash can be managed without dropping the lower sash."

*Claim.*—"What I claim as my invention is, 1st, Arranging the spring catch fastenings for the upper and lower sash, about the middle of the frame, in such a manner that the upper sash can be managed, or fastened and unfastened, without interference from the lower sash, substantially in the manner herein set forth. 2d, I claim the particular arrangement of the attachments on the one plate of the two spring fastenings; said arrangement consisting of the swing bar, (through which the spring bolt of the upper sash is operated,) with its hinge joint in the rear of the spring bolt, and the bar and bolt of the lower sash, by which I gain economy of room, and a cheap and efficient action upon the two sashes, in the manner set forth."

7. For an *Improvement in Processes for Preparing Vegetable Fibre;* Chas. J. Pownall, Addison Road, England; patented in England for Ireland, August 11, 1852.

*Claim.*—"I claim as of my invention the mode of subjecting fibrous vegetable substances to repeated mechanical pressure and the action of a stream of water, for the purpose of depriving them of resinous or gummy matters, and also resolving them into their ultimate or finer fibre, in manner herein before described."

8. For an *Improvement in Sector Presses;* Samuel Rust, City of New York.

*Claim.*—"What I claim as my invention is, 1st, one or more bearing pieces at the sides or in front of the eccentric sector, acting upon any fixed point or rest on the press frame, for the purpose of raising or withdrawing the punch or pressing appendage, by power applied to the sector, in the reverse direction to that by which the pressure is given, substantially in the manner specified. 2d, I claim allowing to the eccentric sector a sufficient amount of motion directly in the line of the pressure, to enable it to follow, and always keep in contact, and in proper relation to the eccentric sector, substantially as herein set forth."

9. For an *Improved Machine for Cutting the Threads of Wood Screws;* Elliot Sawyer, Berlin, Connecticut.

*Claim.*—"I do not claim the invention of the combination of mechanism for holding and rotating a screw blank, and mechanism for carrying a cutter or chisel against the blank, and regulating the movements of that cutter by a screw; but what I do claim as my invention or improvement is, the endless elongated chaser, as constructed and made to turn and move on a pin, or its equivalent, and to act against a screw blank while in rotation and movement, as specified. And in combination with the elongated endless chaser and the screw blank holder, I claim the feeding cam or apparatus, so applied as to be operated by the chaser, and feed it forwards against the screw blank, substantially as specified. And in combination with the elongated endless chaser and its sustaining car-

riage, I claim the movable rail and groove, together with mechanism for elevating and depressing the rail, in manner and for the purpose as stated; the mechanism as above described for such purpose being the two grooves and their inclined planes, and the studs and the springs of the rails. And in combination with the elongated endless chaser and its operative screw, and elongated endless worm gear, and the feeding apparatus of the chaser, I claim mechanism for withdrawing the driverfrom the head of the screw, or releasing the screw from the machinery by which it is put in rotation; mechanism for removing the cut screw from the endless chaser, and presenting another screw blank to the operation of it, as described; and mechanism for restoring the driver and other parts to their correct positions, to again set in motion the screw cutting machinery; the machinery, as described for actuating the driver, being the cam, the pitman, the rocker shaft, the bent arm, and the forked lever; that for removing the cut screw from the chaser, and presenting to it a fresh screw blank, being the rotary blank holder, the gear wheel, and the arms; that for restoring the driver and other parts to their correct positions, to again set in motion the screw cutting machinery, being the pitman and the spring; the whole being applied and made to operate together, substantially as specified."

10. For an *Improvement in Weaving Corded Fabrics;* Wm. Smith, City of New York.

"The object of my invention is to furnish means for weaving fabrics formed by a centre warp of india rubber, for corrugated elastic goods, or any similar warp which is enclosed by a fabric formed on each side of it, by filling from two shuttles, one passing above and the other below the centre warp, which is stationary, the sheds being formed by upper and lower warps, worked in any usual manner."

*Claim.*—"I do not claim two shuttles, as two or more have been used in various kinds of weaving; but what I claim is, the process of forming a fabric by the combination of stationary movable warps, with two weft threads passed simultaneously through the two sheds formed above and below said stationary warps by the movable warps."

11. For an *Improved Process for Mixing Air and Steam for Actuating Engines;* Wm. Mt. Storm, City of New York.

*Claim.*—"Having specified my present invention, what I claim is, generating the steam for admixture with the air, or other gaseous body, in direct contact with the latter; the same, *i. e.*, the air or gas, not being the hot product of combustion, nor to arrive at the place of admixture from direct contact with any body of fuel undergoing combustion for the reasons explained. Further, I claim the plan of generating the steam for such said purpose, in some (comparatively as explained) dry vessel or heater for the reasons given; the water from which such steam is so generated being mainly held, while vaporizing, in suspension in the air, for the objects specified; and the air and water to that end being caused by some adequate means to meet with an extensive surface of mutual contact, as I have explained and shown."

12. For an *Improvement in Brakes for Railroad Cars;* George Frinks, Jersey City, N. J.

*Claim.*—"Having fully described the nature of my invention, what I claim therein as new is, the so combining the shoe frame with the ordinary truck or car, as that it may be raised and lowered by the operation of the brake lever, so as to be carried by the truck, or to receive the weight of the car, to aid in applying the brakes, and so that the wheels shall not come in contact with the shoes, but be free to turn, substantially as described. I also claim giving the truck or car a motion independent of the shoe, or brake frame, by means of the curved inclined planes, or their equivalents, on the shoe frame, up which the axles of the trucks may roll, by an easy swinging motion, whilst its entire weight continues to aid in applying the shoe or brake to the surface of the rails, substantially as herein described."

13. For an *Improvement in Stoves;* John J. Updegraff, Selins Grove, Pennsylvania.

"My improvements consist chiefly in arrangements of the parts of the stove, so as to combine an extensive radiating surface with an extensive air heating surface, or rather, to make the surfaces extensive; and also in other arrangements or combinations for the economy of heat, as will be hereinafter specified."

*Claim.*—"What I claim is, 1st, The combination of the central hot air passage, the annular fire chamber, and tubular fire pot, for the full economy of heat, as set forth. 2d, The combination of the outer casing, the tubular fire pot, and the central hot air passage, in the manner described, so that the currents from each may all unite and co-operate as set forth."

# FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, April 21, 1853.*

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

Joseph P. Parke, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

Donations to the Library were received from The Royal Astronomical Society, and the Society of Arts, Manufactures, and Commerce, London; The Royal Irish Academy, Dublin; The Ecole Nationale des Mines, Paris; Chs. B. Stuart, Engineer in Chief U. S. Navy; Capt. M. C. Meigs, U. S. Engineer Corps; Hon. Joseph R. Chandler, U. S. Congress; The Bellefontaine and Indiana Railroad Co., Marion, Ohio; The South Carolina Institute, Charleston, S. C.; The Library Association of St. Louis, Missouri; Wm. Jackson, Esq., Newton, Mass.; The State Lunatic Asylum, Utica, New York; Prof. Martyn Paine, M. D., City of New York; G. H. Hart, Esq., Pennsylvania Legislature, and from Chas. Ellet, Jr., Esq., Civil Eng., Frederick Graff, Esq., Dr. B. Howard Rand, and Messrs. Birkinbine & Trotter, Philadelphia.

Donations to the Cabinet from Wm. W. Fleming, Esq., and Abiel Elliot, Esq., Philadelphia.

George W. Conarroe, Esq., presented a half length portrait of S. V. Merrick, President of the Institute, painted by the donor for the rooms of the Institute.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of March.

The Board of Managers and Standing Committees reported their minutes.

On motion, the Committee on Exhibitions were instructed to take the necessary steps to hold an Exhibition of American Manufactures next fall, agreeably to their recommendation this evening.

Resignations of membership in the Institute (3) were read and accepted.

New candidates for membership in the Institute (6) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

On motion, a special vote of thanks to G. W. Conarroe, Esq., was passed for his valuable donation of a portrait of the President of the Institute.

Dr. Rand, Chairman of the Committee on Meetings, brought before the meeting a model of the U. S. Army wagon, for which he is indebted to Maj. Crossman, U. S. A. The wagons are made by Messrs. Wilson, Childs & Co., of this city. Dr. Rand read the following note from Maj. Crossman:

B. H. Rand, M. D.

My Dear Sir:—Agreeably to your request, I send you herewith, my model of the Army baggage wagons which I am now having manufactured in this City for the public service. Annexed is a description, in minute detail, of every part of these wagons, printed for use in the form of a contract, so that in the event of war, and a sudden need of a very

large number of them, these printed descriptions can be distributed amongst the different manufacturers, to secure exact uniformity of construction in all respects. It is in the entire fulfilment of these conditions, by which every part of these wagons are made with the same exactitude of dimensions, (like the gun carriage of a park of artillery,) that the chief merit of my improvements for military purposes consists; for the same actual necessity exists for strict uniformity in the construction of all carriages used for the transportation of army supplies and material of war, as for a uniformity in the calibre of cannon and small arms, or the size of shot, shell, and fixed ammunition. The confusion and delay as well as the enormous expense incurred during the Black Hawk war, in 1832, the Creek and Seminole campaigns of 1836–37, and the war with Mexico, for the want of some fixed system of baggage wagons for the use of the army, induced me, long since, to turn my attention to this matter; and my location in this City, since the termination of the Mexican war, has enabled me by the aid of some of your excellent mechanics, and the sanction of my chief, General Jesup, Quartermaster General, to improve from time to time upon the old pattern, and to make such arrangements as at least to fulfil all the conditions required in the manufacture of these wagons, as well as at all times to secure a large supply of them in a very short time.

The coach tongue arrangement of the jaws of the front hounds, and the heavy iron bracing of them, as seen in the model, enables us by merely reversing the two iron plates at the mouth and throat of these hounds, to convert these carriages at once into ox wagons; although ordinarily they are intended to be drawn by six mules.

Every wagon is provided with an equipment of staples, mortises, and iron rings, in the lower frame pieces and fore holsters of the bodies, by which india rubber floats can be attached for the crossing rivers without unloading it; and when unloaded, the bodies of these wagons are so made as to be easily converted into boats capable of carrying across a river fifteen or twenty men each, by merely caulking the seams with a mixture of tallow, or any animal grease, or tar and wood ashes, or even using simple mud.

The weight of these wagons, complete, is 1780 pounds, which has been by some objected to as too heavy; but when it is considered that they are required for all kinds of service, including the carrying of shot and shells, and fixed ammunition, for an army, as well as its subsistence, forage, and clothing, and are compelled to travel over the roughest mountain regions, where no road has been marked out, as well upon the smooth, level prairie, whose general surface presents no obstacle, it will be seen that there is neither too much strength nor weight in these wagons for all kinds of work, and for every description of roads.

Since I came to this City in 1848, I have had manufactured here, altogether, nearly thirteen hundred baggage wagons, more than two-thirds of which have been of the improved model, now shown to you; and these have been sent to Texas, New Mexico, and California, and used constantly with the troops stationed there.

They have been used in transporting supplies of all kinds to our extreme frontier stations; and sometimes, when drawn by five yoke of oxen, have carried 4000 pounds more than eight hundred miles, over the roughest, stony, trackless desert, perhaps, in the world, lying between Lavacca Bay, on the Gulf of Mexico, and El Passo, on the Rio Grande; and I never yet heard of a break of any important part of them—never once of an axle or a wheel. I am, &c. G. H. CROSSMAN.

*Philadelphia, 1st April,* 1853.

Dr. Rand remarked that in the transportation of the clothing and equipage of the Army, an improved system of baleing had been recently introduced. The goods are packed at the general depot on the Schuylkill near Gray's Ferry. The bales are all of the uniform size of 3 feet long, 2 feet wide, and 18 inches deep, and are made entirely water proof. They have been tested by soaking in the Schuylkill for two days, as well as in cases of wrecks on the coast, and in the western rivers, without the contained goods being injured, in any case in which the baleing remained whole. From the uniform size of both wagons and bales, it can be immediately calculated how many wagons are required to transport a known quantity of stores.

Dr. Seth E. Winslow exhibited an improved fluid lamp, designed to prevent the necessity of frequently filling it. The base is made hollow

to contain the burning fluid, which is supplied to the globe of the lamp through a tube reaching nearly to its top. When the fluid in the globe is nearly exhausted, more is supplied by simply inverting the lamp.

Dr. Winslow also exhibited a contrivance for moving a fan by the motion of an ordinary rocking chair.

A wooden case is attached to the back and to the hinder part of the rocker. Within this case is a rod moving vertically, projecting from the lower end of the case so as to touch the floor, and having at its upper end a cord passing around a pulley, into which is inserted the handle of the fan. When the chair is rocked, its backward movement forces up the rod, which is repelled by means of a spiral spring. Motion is thus given to the pulley, and consequently to the fan.

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## COMMITTEE ON SCIENCE AND THE ARTS.

### *Report on Deschamps' Improvements in Omnibus Registers.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "an Improvement in Omnibus Registers," invented by Mr. F. O. Deschamps, of Philadelphia, Pennsylvania—REPORT:

The instrument is placed in the front part of the omnibus, between the lamp and the hole by which the fare is passed up to the driver. It resembles in appearance the dial of a common clock with a single index.

It is the duty of the driver upon the receipt of each fare, to pull a handle, which rings a bell inside the instrument, and at the same time causes the index to move forward on the dial one division, while a similar record is made by a second dial, which is placed upon the same arbor as the centre wheel, and the hand or pointer, and is concealed behind the face of the first dial. When the index in the first dial, and consequently the second dial, have made an entire revolution, by means of a toothed wheel, notched cylinder and click, a second concealed dial is moved forward one division, corresponding in the instrument examined by the committee, to 36 divisions on the first dial. By this means any number of fares desired may be registered on the concealed dials. In the instrument examined by the Committee, the record exceeded 10,000.

The outer dial is examined by the agent at the terminus of the route at the end of each trip, the number of divisions passed over by the index noted, and the hand returned to zero. Each dial may be turned back without affecting the record upon that which enumerates the higher numbers.

The second and third dials are concealed behind the first, and their index numbers are brought into view by a key, in the possession of a second agent. This key slides back portions of the face or first dial, covering the indicating part of each; thus enabling them to be read, but not moved.

The concealed dials can only be reversed by means of a third key, which is in the hands of the proprietors alone. When they are exposed, the ringing apparatus is locked, and they cannot be moved forward.

Hence it may be seen that if the driver neglects to pull the bell, his dishonesty becomes apparent to all within the coach, among whom may

be a secret agent of the proprietors, and the knowledge of this fact will tend to prevent any such attempt being made on his part.

The first agent who inspects the dial at the end of each trip, can only open the glass covering its face, and cannot expose the concealed dials. The second agent who inspects the concealed dials at the end of the day, cannot alter them, but acts as a check upon the driver and the first agent, while it is in the power of the proprietors to satisfy themselves, at any time, of the correctness of his records, by examining for themselves the concealed dials.

From a careful examination, the Committee is satisfied, that when the bell is once rung, it is impossible for the driver, agents, or any other persons, even when in possession of the first two keys, to prevent the record of the same coming to the knowledge of the proprietors, without their tampering with the instrument becoming evident.

As to the originality of Mr. Deschamps' improvements, the Committee has no positive testimony to offer. It is aware that register dials have been in use for years, in the English and French omnibuses. Mr. Deschamps claims the following improvements:

1. The use of the ratchet wheel and its pawl, or their equivalents, so arranged that it is impossible to ring the bell by a *recoil* of the hammer, and consequently each stroke must be recorded on the dials.

2. The combination of the toothed wheel, to which the dial plate is affixed, with the notched cylinder and the click, whereby the third dial plate is impelled one notch at each revolution of the second dial plate, thus registering on the concealed dials any number of fares registered in the visible dial plate.

In the French instrument examined by the Committee, the record did not extend above 34 figures. This instrument is portable, and managed by the conductor. It was shown to the Committee, that in it the bell may be rung by the recoil of the hammer, and no record consequently be made. It was also possible to alter the index, by means of a pick inserted in the key hole, which is not covered.

The Committee has no evidence that the improvements claimed by Mr. Deschamps have been before introduced.

The Committee believes that the general introduction of this instrument would not only benefit the owners of omnibuses, but would have a more extended effect. Without wishing to make a general or sweeping assertion against the characters of omnibus drivers as a class, it may be said that it is notorious, that under the existing arrangements, a large proportion of the fares paid by passengers does not reach the proprietors. The temptation to dishonesty held out is so great, that but few men, earning the low wages of omnibus drivers, could resist it. Even if a man sets out with the intention and desire to prove faithful to his employers, the example of others, the stimulus of necessity, the ease with which the abstraction may be made, and the small risk of detection, will often frustrate his good intentions. It is asserted, indeed, that the dishonest drivers will often combine against an honest one, and by means well known to those who have watched them, draw away his passengers, and thus make his daily payments to the proprietors less than their own.

The Committee believes that the introduction of this instrument, which

renders fraud almost certain to be detected, will tend to elevate the character of the drivers as a class; while the increased receipts from the coaches will enable the proprietors to raise their wages in proportion.

In conclusion, the Committee considers the instrument of Mr. Deschamps as highly ingenious, and has no doubt that in practice it must prove a simple and effectual check upon the dishonesty of drivers and agents.

For the register exhibited at the last exhibition, and referred to this Committee, by the Committee on Exhibitions, it is recommended that a first premium be awarded by that Committee.

By order of the Committee.

WM. HAMILTON, *Actuary.*

Philadelphia, March 10th, 1853.

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## *Report on Sewing Machines.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Improvements in Sewing Machines," invented by Messrs. J. P. Martin; I. M. Singer; and Odeon and Erling, of Philadelphia, Pennsylvania—REPORT:

An elaborate review of the whole subject of Sewing Machines, would require a degree of labor, to which we cannot now devote the requisite time; nevertheless, a careful examination of the matter has been made, because it is worthy of research, and all that can be done in promoting their application to the purposes of manufacture and domestic economy, will necessarily fall short of their recognised utility, in reducing manual labour, especially on the part of the sex whose welfare we are bound to protect and cherish. If this view needs enforcement, let him who doubts read the "Song of the Shirt;" if his feelings do not respond, he is unworthy of the name he bears or the form he wears.

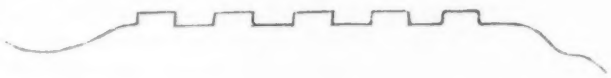
Our first step is to notice briefly the "stitches" which are produced by mechanical sewing. The "chain stitch" is probably the oldest of them, or more properly, that first employed, and has been so employed from a very early period. In the tambouring machine, it consists of a series of loops, of which the following diagram will serve as an illustration:

Most of the early sewing machines employed this stitch, and it is still employed, with propriety, for ornamental purposes; but it is not approved of, when strength or durability is required, as it will "run" if the thread breaks, and, as is evident on inspection of the diagram, may all be "run" out by drawing the end of the thread on the right.

The distinctive appellation, thread, is used throughout this report. It is ntended to express the sewing material in its comprehensive sense, not confining it to its strict application to spun flax, usually called thread,

but to all material, from the finest cotton and silk to twine, as employed in making seams by the sewing machine.

The next stitch in order of priority, comes under the denomination of "running." It is accomplished by means of a needle, with points at each end, and an eye in the middle. Its form is illustrated thus:



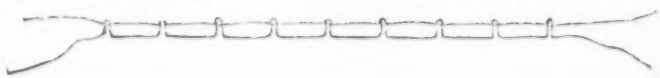
It has been extensively employed for the cheaper kinds of work, such as bags, &c., but cannot with propriety be applied to uses requiring durability, as it does not draw the work well together, and if a thread breaks, runs each way to a ruinous extent. The same machine it is evident could be made capable of sewing a "back stitch," thus,

by means of an alternate backward feed, and would then imitate the stitch popularly known by the above title, and approved by seamstresses; but happily, the necessity has been superseded by the invention of a stitch greatly superior, to which we shall have occasion to refer at a future moment.

The needle with an eye in the centre, and double pointed, is beautifully employed in the embroidering machine, which dates back beyond the exhibition of arts and manufactures in Paris, in the years 1834 and 5, and worked upon cloth as many as sixty similar figures or flowers at the same time; the whole being directed by one hand, who by the aid of a pentagraphic guide on a prepared pattern, pointed the needles to their appropriate place of entrance, and return, with unerring certainty and exactitude.

We now come to the principle of the sewing machine, in its advanced state, or approaching to the perfect instrument; not that it is incapable of improvement, for perfection is a word which applies rarely in mechanics. We have no hesitation in saying, there is yet much to be done; we leave the development to time and experience, in the confident belief that opportunity and necessity will produce their fruit.

Our diagram will exhibit the stitch; it will be perceived at a glance



that two threads are employed. The lower one, or "wrong side" thread, being termed in the patent office report, of 1848, the "auxiliary thread," and is supplied or fed by a shuttle and bobbin; in this consists the peculiar principle of the best sewing machines, and in this, we may be allowed to observe, we believe their utility to consist, and to it may be attributed their superiority over all hand sewing. We may as well demon-

strate this fact, before we proceed further with our report. Whenever a "needle full of thread" is employed, either by machine or hand, it is passed into the work with the needle, and drawn through until it closes up the seam, and this operation is repeated, stitch by stitch, until the "needlefull" is used up, and has been worn in exact proportion to the number of stitches taken, and must then be fastened off. It is then renewed, to undergo the same operation, the "fastening off" not unfrequently being carelessly done, the unequally worn and sometimes worn out thread being incapable of producing work bearing any comparison with the work of a machine, which wears only as much of thread as is necessary to make the stitch, and goes on without "fastening off" until the seam is finished, whether it be the "side seam" of a pair of pants, or the mainsail of a man of war.

Mention has been made of a patent for the use of two needles, one working horizontally, the other vertically. It is possible that another stitch is made by this machine, but as it has not fallen under our notice, and no specimen of its work has reached us, we cannot be expected to give any further notice of it.

Having, as we hope, given a brief but intelligible notice of stitches, and especially of that peculiar one employed, we proceed to describe the means by which it is effected.

The needle is secured in a stock, whose movement drives its point through the material to be sewed; the eye at a moderate distance from the point, carries the thread through, and then retires, leaving a loop, through which loop a shuttle is passed, on the under side of the material to be sewed; this shuttle carries a quantity of thread upon a spool, which it supplies as the seam progresses. The needle on retiring draws up the loop, and thus closes the seam, which on the upper or face side of the work, presents the appearance of what is called a "row of stitching," and on the under, a close resemblance, but differing slightly.

The return or rotation of the shuttle in its orbit, by the general movements of the machine, is a matter of course, and the work thus goes on continuously and with great rapidity.

The next subject of attention is the *feed*, or progressive movement of the material, which is accomplished by various means, generally, however, by the friction of a feeding wheel, whose roughened surface creates sufficient adhesion to move the material forward at the requisite intervals. This feed is effected by the ordinary means of a ratchet wheel and click or pawl, the latter capable of adjustment by shifting levers, so as to give a longer or shorter stitch, at the will of the operator or the requirements of the work.

Numerous patents are on record for sewing machines; an examination of their claims leads to the conclusion, that the peculiar and most valuable principle employed in them, that is to say, the employment of the double or auxiliary thread, is thrown open to the public use. We have some reason to suppose that it was employed as early as 1826.

Between the fourth of March, 1843, and April, 1850, there are seven patents; there are six in 1850, and four in 1851; how many subsequently we are not informed. Amid such a mass, it cannot be expected that we

should sift the chaff from the wheat; their claims are principally for modification of parts, in seventeen or twenty varieties, and just such modifications as experience and peculiarities of application would suggest; we can report in approbation of those which have been submitted to inspection.

Mr. J. P. Martin calls the machine which he has submitted, "self regulating," and claims for it great advantages, in stopping when the thread breaks, or a loop is missed. We think that his claim is well founded; it must certainly be important to arrest the movement whenever such accidents happen. We think that a just analogy is inferred in this respect with the power loom, which would be of greatly reduced practical utility without that function. The means by which the machine is arrested in its movement by an accidental derangement of the thread, or the breaking of it, is ingenious in the highest degree.

The Committee in accordance with this view, recommend the Committee on Exhibitions to award to Mr. J. P. Martin a first premium.

The machine of Mr. Isaac M. Singer is certainly very successful and satisfactory in its operation, and capable of doing the best of work; the method of tightening the threads, and drawing in the seam, is averred to be an important improvement, in which estimation we coincide.

As Mr. Singer has received the award of a first premium, at the late Exhibition of the Institute, we cannot do more than express our approbation, and give our testimony, as to the propriety of that award.

By order of the Committee.

WM. HAMILTON, *Actuary.*

Philadelphia, March 10th, 1853.

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## *Report on E. W. Bean's Zenith Instrument.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, the Zenith Instrument, invented by Mr. E. W. Bean, of Hatboro', Pennsylvania—REPORT:

That the invention consists in the employment of a telescope, so mounted as to be freely movable in a vertical plane, upon an axis which is itself kept vertical and capable of moving on pivots in a horizontal plane; thus giving to the telescope a motion in azimuth and altitude. Its motion in altitude is governed by a differential screw having a graduated head. The method of using it is to set the telescope upon a star as it passes the meridian, read its position by the graduation, and then direct it to another star, which passes the meridian later, by turning the differential screw by which the motion in altitude is governed. Should the second star pass the meridian on the opposite side of the zenith from the first, the vertical axis is turned upon its pivots through 180°, and the observation proceeded with as before. In this way, the difference of the zenith distances of two stars can be determined by easy manipulations, and the measurement by the differential screw can be read to a greater degree of accuracy than by the micrometer apparatus generally used for this pur-

pose. In the explanation of the inventor, nothing is said of the method of insuring observations in the meridian, (since the instrument is capable of free movement in azimuth;) but this can be easily attained, either by meridian marks, established beforehand, or by following the star so as to get the observation of the least zenith distance.

The Committee believe the proposal to use the differential screw for the purpose of accurately recording minute differences of altitude is new, and capable of useful application for practical purposes, and they recommend that a description of the instrument be published in the *Journal* of the Institute.

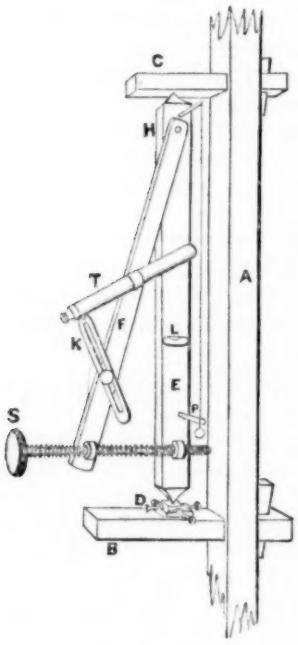
By order of the Committee.

WM. HAMILTON, *Actuary.*

Philadelphia, February 10, 1853.

MR. WM. HAMILTON, Actuary Franklin Institute.

RESPECTED FRIEND:—Will you please lay before a Committee of the Franklin Institute for examination, the following described instrument for determining difference of zenith distances, and thence the latitude of the place?




Let A be a post 8 or 10 feet, or more, as may be required, in which are inserted two arms, one near the bottom, B, and the other, C, near the top of the post, firmly secured by keys or braces. In the arm, C, insert the vertical axis, E, and at the bottom insert the axis, E, into a piece inserted into the screw box, D, capable of being adjusted to a vertical position by means of the 4 screws in the box, D, the verticality of the axis, E, being known by the level, L, attached thereto, or by the plummet, P, suspended from near the top of the axis, and coinciding with a mark or an index near P. To this vertical axis, E, is attached another, F, attached to the former near the top at H, as a centre. At the lower end of this is attached a differential screw, S, by a pivot nut corresponding with the coarser end of the screw; the other end of the differential screw being attached by a similar pivot nut to the vertical axis, E. To the axis, F, is applied the telescope, T, capable of being clamped in any position by the clamp, K. Now, to find the difference of zenith distances, (a value of one turn of the differential screw being known by experiment,) let the instrument be brought in adjustment with the axis, E, vertical either by the level, L, or plumb line, P; then bring the thread of the telescope to bear on a star either north or south of the zenith when passing the meridian. Now revolve the instrument on its

axis, E, (it being capable of making a complete revolution,) so that the telescope may point to the meridian in the opposite side of the zenith, and observe a star passing the meridian by means of turning the differential screw until the thread of the telescope cuts the star; the number of turns of the differential screw will indicate the angular difference of the zenith distance of the two stars, one north and the other south of the zenith, supposing no change of refraction to take place during the interval of observing. Let this difference be called $a$. The sum of the zenith distances is the difference of polar distances of the two stars, which call $b$. Then $\frac{a+b}{2}$ will be the zenith distance of the star furthest from the zenith; and $\frac{a-b}{2}$ will be the zenith distance of the star nearest the zenith of the place of observation; whence the latitude is readily determined.

The value of a turn of the differential screw may be found by having the number of threads of each end of the screw to an inch, viz: multiply the number of threads to an inch in the coarser part of the screw by the number of threads to an inch in the finer part of the screw, and divide the product by the difference of threads to an inch in each part; the quotient will be the number of revolutions the differential screw makes to an inch. For example, suppose the one part of the screw has 20 and the other 30 threads to an inch, then $\frac{20 \times 30}{30-20} = \frac{600}{10} = 60$ revolutions the differential screw makes to an inch.

Again: take 25 and 30; then $\frac{25 \times 30}{30-25} = \frac{750}{5} = 150$ to an inch, and as the head of the differential screw may be divided, we may get a very exact reading of the distance moved over, or difference of zenith distances.

In order that the screw may not be too long to give greater differences of zenith distances, to extend the usefulness of the instrument, and multiply the observations, an arm may be inserted in the vertical axis, E, and another in the axis, F, one sliding over the other; one of them being graduated to $\frac{1}{10}$-inch, or parts of degrees, as may be desired, and a mark on the other to be brought to coincide with any of them, and then clamped; then for the rest of the difference of the zenith distance, the differential screw may be used. It is evident that other methods of finding a value of a revolution of the differential screw may be employed.

This method of obtaining the difference of zenith distances of the stars, I believe to be more exact than any other method I have known. The method of obtaining difference of zenith distances by a micrometer screw in the tube of the telescope, is certainly inferior in accuracy to this method, inasmuch as the readings of my method may be equally exact with the other, and the radius of motion being say 8 feet or more; while by the other method it is but the focal disk of the eye glass, say from 1 to 3 inches, or in proportion of say 96 to 1 or 3.

E. W. Beans.

*Hatboro', Montgomery Co., Penna., Nov.* 23, 1852.